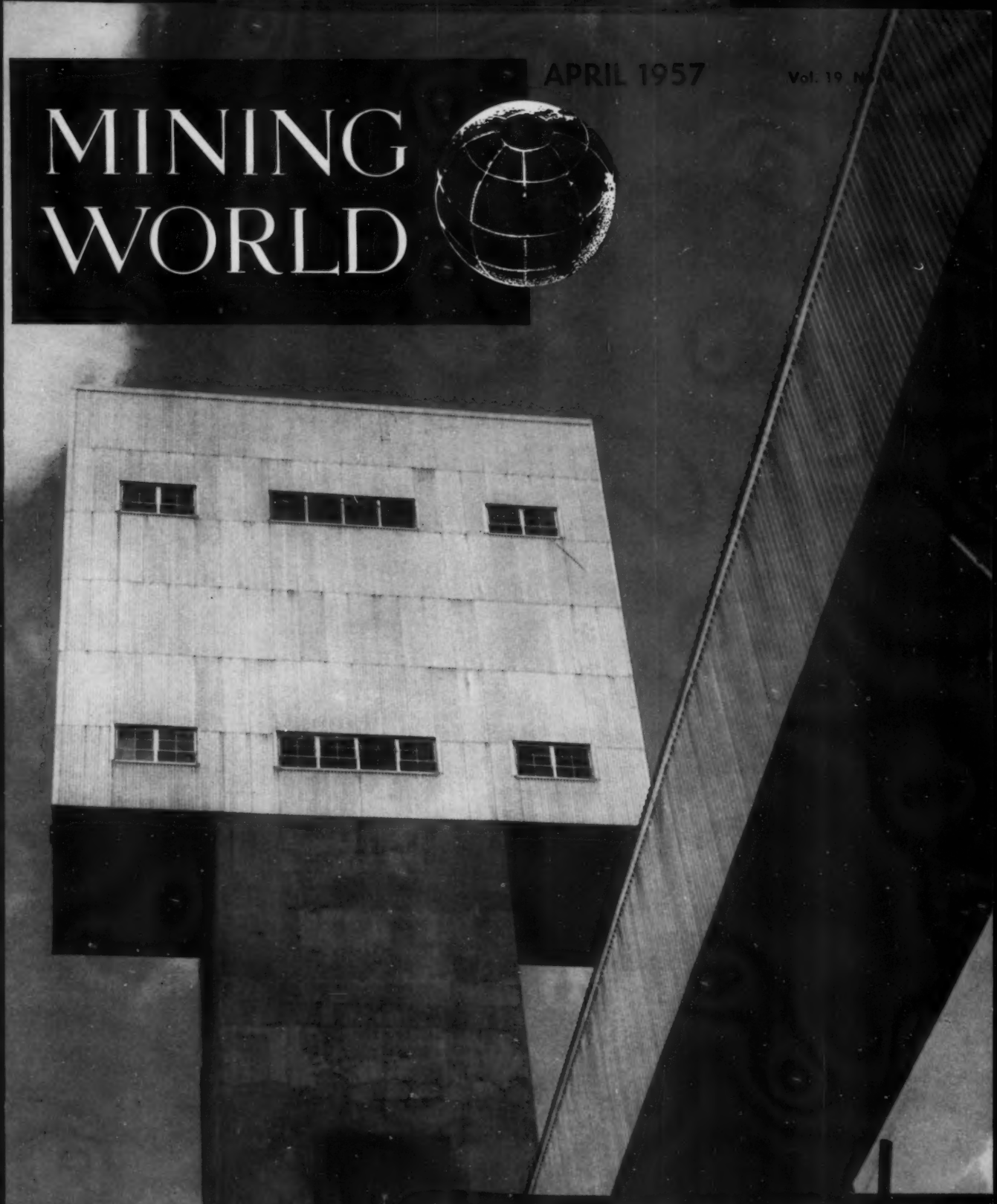
APRIL 1957 Vol. 19 No.

MINING WORLD



Cleveland-Cliffs "C" Shaft Koepe Hoisting

Page 44

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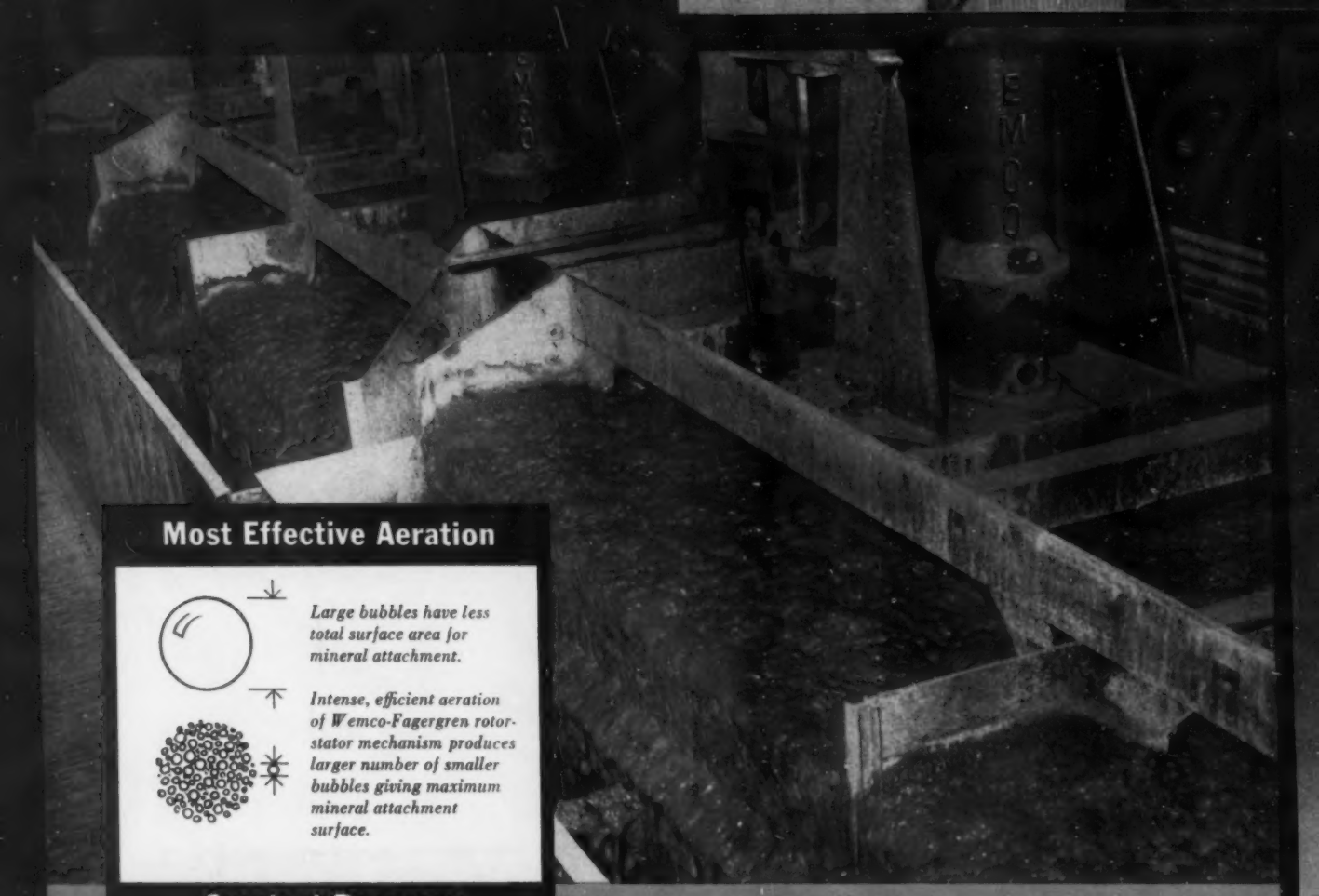

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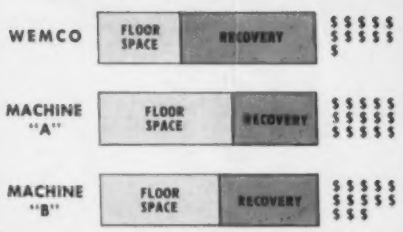

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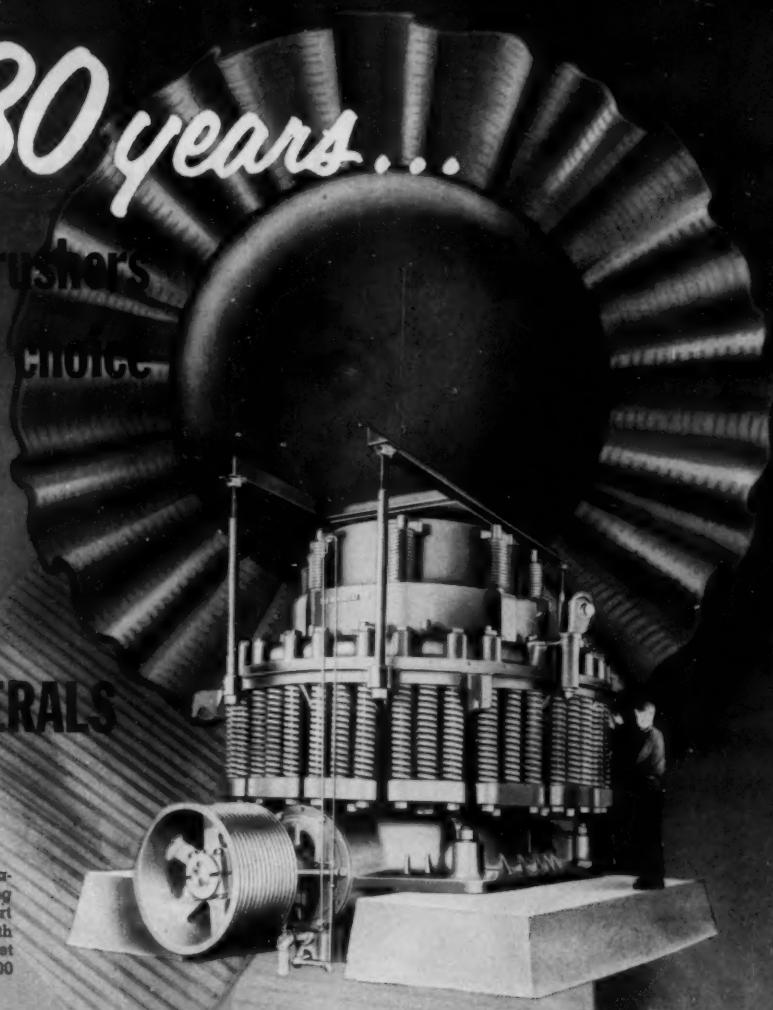

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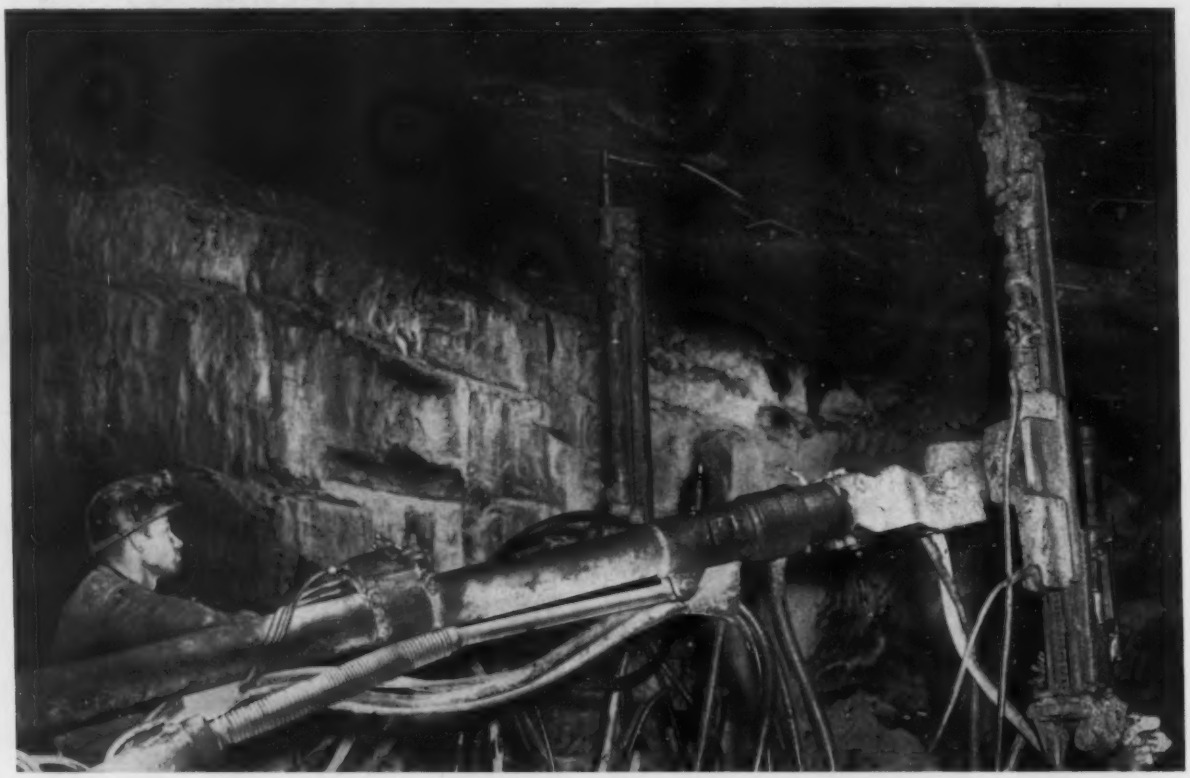
ENGINEER'S FIELD REPORT

LUBRICANT CHEVRON* VISTAC OIL

LOCATION A COAL MINE IN UTAH

Chevron* Vistac Oil protects mine roof bolters operating in water and heavy abrasive dust



WORKING CONSTANTLY in heavy abrasive dust, high humidity and water in one of Utah's largest coal mines, these Joy roof bolters are lubricated with Chevron* Vistac Oil. To eliminate crossbar timbering and provide greater safety and increased production, these air tools drill holes, hammer bolts and tighten nuts on steel bearing plates. Bolts up to 8 feet long are rammed in to refusal at pressures up to 3,000 lbs. psi.

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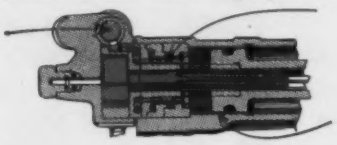

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* The Chevron Brand covers the line of industrial products formerly sold under the Calol name. This is a name change only. The high quality and specifications remain the same.

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Mining World

Including the Export Edition **WORLD MINING**

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VOLUME 19 **APRIL 1957** NO. 4

OPERATIONS-TECHNOLOGY

Mining

Strawberry Tungsten Overcomes Many Problems 40

Heavy snows and remote location make operations difficult at this small California mine. Ore is mined in shrink stopes and milled in a gravity-flotation circuit. Ingenuity of management has solved many operational problems.

Koepe Hoisting At Cleveland-Cliffs' "C" Shaft 44

By Henry G. Grundstedt

Cleveland-Cliffs centralized hoisting, eliminated labor, and increased capacity at the "C" shaft in Ishpeming, Michigan by installing the first Koepe (friction type) hoist at any United States metal mine.

Milling

How Otanmaki Floats Ilmenite In Finland 49

By Urmas Runolinna

Otanmaki ore is titaniferous magnetite which requires fine grinding to free mineral grains. Magnetite is recovered by a series of magnetic separators. Ilmenite is floated from magnetite tailing with tall oil.

Recovering V_2O_5 From Otanmaki Magnetite Concentrate 55

By Martti Merenmies

Magnetite concentrate assays 0.5 percent V_2O_5. Vanadium is recovered by a salt roast, leaching, and precipitation with sulphuric acid.

Exploration

How Colored Stereoscopic Photographs Aid Ore Search 56

By Philip A. Laylander

This is the second similar article by the author. Since the first article new techniques and evaluation experience gained in the last five years give added clues for ore search. Costs are estimated for surveying various western mining districts.

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ON THE COVER

Concrete head frame towers 174 feet over the collar of Cleveland-Cliffs' "C" shaft at Ishpeming, Michigan. Koepe (friction type) hoists are placed in the top of the headframe. You will see more of these headframes at United States mines following successful pioneering by Cleveland-Cliffs.

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Drifts and Crosscuts

Thanks For Your Help

How many of you have noticed the small "Eastman Research" emblem on page 3 of recent issues and wondered what it meant?

This symbol represents the best "Consulting Engineers" of the Printing World. Eastman Research is a unique organization which has devoted many years to finding out how to print a better technical magazine with only one purpose. That purpose is to make a better magazine for you—the reader.

MINING WORLD editors are mining and metallurgical engineers, and following the best engineering practice have called in highly qualified consultants to advise them on how to do a better job for you—the reader. For the readers are the mining stockholders in MINING WORLD whom the Editors must serve as engineers. Not for a minute will Eastman Research advise the editors about solvent extraction, panel caving, or the helicopter electromagnetometer. But, Eastman will report and recommend how the Editors can make MINING WORLD more valuable for the reader.

Trained Eastman interviewers visited many of you during March in the Arizona copper camps, the Utah uranium mines, and the Mesabi iron pits to get your views and opinions about all sections of MINING WORLD.

Thank you for helping the consulting researchers help the Editors help you—the reader.

Spiralling Costs of Iron Ore Mining

A recent issue of *Cliffs News*, the employee publication of the Cleveland-Cliffs Iron Company, presented a clear picture of the effects of the rising spiral of living costs and how Michigan iron ore mining fits into the picture. Highlights show that from 1950 to end of 1956 there was a 28.8 percent increase in the market price for Old Range non-Bessemer iron ore at the mine. The straight time hourly wage rate increased 77.2 percent, total fringe benefit 128.5 percent, and the total average hourly rate and fringe benefits 85.1 percent during same time.

During the same period the average output in tons per man day increased from 6.24 to 8.71, an increase of 39.5 percent. It also cost about twice as much in 1956 to provide a job for a miner.

In the face of these increased production costs, Cleveland-Cliffs has had to add new equipment and more expensive equipment to stay in business. The article on the new Koepe hoist starting on page 44 at the company's Cliffs shaft describes one of the important ways Cleveland-Cliffs tries to overcome spiralling costs.

Mines must mechanize to survive.

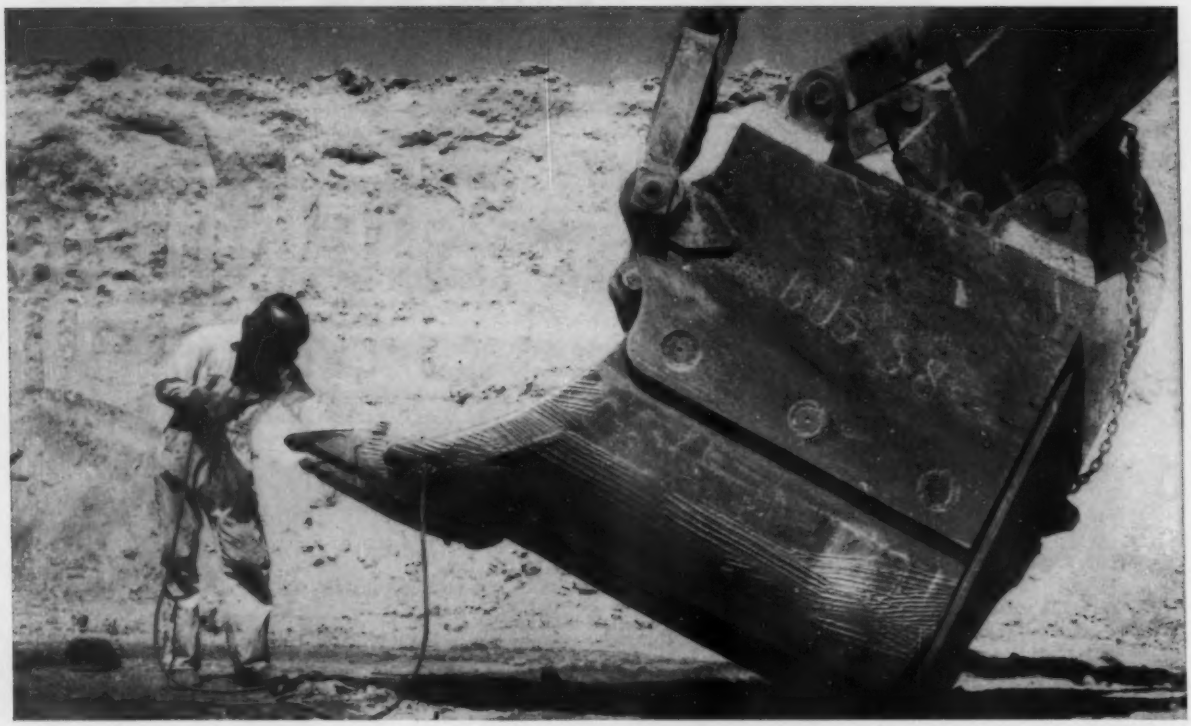
Watch For the Big Yearbook

Your next copy of MINING WORLD will be the big annual Yearbook; the mining industry's leading year-round reference book. This is the one and only Yearbook that records events of the past year and serves as a guide to the future. All material is arranged for easy use and reference—the informative metal production charts, the detailed tabulations of metal production in all parts of the world, and the easy reading text that highlights major developments. The metal production and mine tonnage tables might, at first glance, seem suitable only for the archives, but far from it. They all point to the future! Smart mining men use them continually to determine trends so that they can figure out what best to do next.

Note how many of the authors of the Metals Section have emphasized the transition from scarcity to abundance. Optimistic forecasts for the future are made. Not that the industry's leading experts, or the MINING WORLD editors, are Crystal Ball gazing experts. However, the best way to see what's ahead is to evaluate what's happened lately—and happening now. You will find in the Yearbook all the latest data about mining everywhere. Use these facts and figures to forecast the future.

To get all the answers, all year, use your MINING WORLD Yearbook.

How STOODY HARD-FACING *keeps* STRIP MINING EQUIPMENT *on-the-GO!*



A few beads of Stoody Electric Tube Borium *keep the points of these shovel teeth out to size, while unprotected teeth lose a full inch of length in the same time.*

Heavy earth moving equipment used in open pit operations lasts far longer and requires fewer replacement parts when wearing surfaces are hard-faced with Stoody alloys. The illustrations show typical examples of both manual and semi-automatic applications. For top welding speed—2 to 4 times faster than manual welding—use Stoody semi-automatic tubular alloy wires... to speed maintenance during short down periods and between shifts, to save time and cut over-all costs.

Ask your Stoody dealer for a free copy of the Stoody Guidebook and the Semi-Automatic Wire folder; this literature covers hard-facing recommendations for all types of heavy equipment. Check the "Yellow Pages" of your phone book for local distributors—or write direct.

Cutters and sides of scrapers *are subject to severe wear. Semi-automatic application of Stoody 100 provides protection.*

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Parallel beads *of Stoody 100 are run along bed of dump trucks to reduce wear in these areas. Material packs between beads, further reducing wear.*

Ripper teeth *have wearing surfaces hard-faced semi-automaticdlly with Stoody 100. 1 or 2 beads of Tube Borium hold points to size.*

Capitol Concentrates

The Long Range Minerals Program Faces Problems of Tariffs, Subsidies, Quotas

Assistant Secretary for Mineral Resources Felix Wormser, in a speech made in New Orleans, Louisiana on February 26, praised the barter program as helping to stabilize and firm the world prices of minerals.

One might ask how it is that the government can take strategic minerals in large quantities for the supplementary stockpile, held under the same terms as the regular national stockpile, when it finds it impossible to purchase additional quantities of these materials for stockpiling. Apparently the question has not been raised. Besides, Mr. Wormser's thesis is dubious in effect, to say the least, and hard to prove.

If recent speeches by the Assistant Secretary were influenced by the draft of the long-range mineral program which Secretary Seaton has not yet presented to the Congress, it would appear that the inclination is against subsidy programs and for tariffs, and/or quotas. In the long run, tariffs and quotas amount to about the same thing as the price to the consumer is raised in the same degree, but in the case of quotas the Treasury does not benefit as much. The Administration, as we all know, generally opposed higher tariffs. In addition, the 50 to 100 percent tariffs which would be required to maintain many of the domestic strategic metal mines would be out of the question even to a tariff-minded Administration. So what is left but subsidies of one kind or another (over-market purchase prices are one form), if the domestic mobilization base is to be maintained?

Another question needs answering. What is meant by marginal and submarginal mines? Mr. Wormser is fond of using the word "submarginal" and seldom says "marginal." At New Orleans he remarked:

"Owners of submarginal mines seek subsidies that they may keep their mines going. Consumers seek price controls on what they buy. So first one special interest, then another, seeks government support, even in boom times. To distinguish which form of support is in the public interest and contributes to the vigor of our competitive domestic economy and which one leads down the road to government controls is of transcendent importance."

He should not have much trouble deciding in his own mind. He was a vigorous foe of the premium price plan and, until he was appointed to his present post, a prime advocate of the Simpson sliding scale tariff bill. Big interests do not like subsidies and the Administration does not like tariffs. Now he is in charge of formulating for the Congress the long-range minerals program. Was ever a man more battered between Scylla and Charybdis?

● What's The Answer?

It is a strange thing that Senator Payne of Maine is so much interested in minerals that he introduced S. 242 to set up a Bureau of Mines mining and metallurgical research laboratory in his state, yet votes consistently against appropriations to aid the mining business.

● Pressure Increases For Metal Mine Inspection

Representative Lee Metcalf of Montana has reintroduced his metal mine inspection bill as H. R. 3639. There has been a flood of similar bills, showing increasing pressure for this measure. Observers say it is likely that additional hearings may be held this year, considering the inconclusive nature of the evidence so far presented to the Metcalf subcommittee.

● Tungsten Mines Provide Vivid Example

What can happen to mines during a shutdown period plus a cut in price is illustrated graphically by what happened to the mines producing tungsten under the Office of Defense Mobilization purchase program when that program was terminated. The price under the ODM program was $63.00 per short ton unit and 793 small and large producers were in operation with no limit to the amount they could sell to the government. In the months following the end of the ODM program many of the mines closed. When buying was resumed under Public Law 733, 84th Congress, 586 mines found it impossible to reopen, either because of the price drop to $55.00 per unit or because they went broke in the interim period. Under P. L. 733 only 207 domestic mines produced tungsten. If the Congress continues to delay appropriation of the money to implement the new program, more producers will drop out as there already has been a substantial additional shut-down period. If the money should be withheld entirely, the roster would be reduced to a mere handful of large producers and there is no assurance that even these can keep going at world prices.

● Senator Green Continues Silver Attack

When Senator Green of Rhode Island reintroduced S. 1201—his perpetual attempt to repeal the Silver Purchase Act—he stated, "This bill will end the subsidy and support price which is paid to the producers of copper, lead, and zinc regardless of need."

It was good of Senator Green to point out that the silver contained in copper, lead, and zinc ores helps to pay for the production of these metals, the producers of which, especially lead and zinc in certain areas, have a tough time getting along as it is. If he could provide the silverware business with cheap material, Senator Green would not care how many mines might have to shut down and throw people out of work, or what sort of government program would be needed to keep the mines operating if this "subsidy" were removed.

Senator Green also said that at hearings held during the 84th Congress a complete case was presented in favor of his bill and that no producers appeared against it. He conveniently forgot to mention that the producers were not given an opportunity to appear.

"THIS D9 HAS DONE EVERYTHING WE HAVE TRIED IT ON YET!"

V. D. Eachus, Eachus Equipment Rental Co., Las Vegas, Nevada

This CAT* D9 Tractor with No. 9S Bulldozer is stripping overburden from gypsum in the Blue Diamond Corporation's operation, Blue Diamond, Nevada. The material is clay and rock. Says V. D. Eachus, owner of the unit: "This D9 has done everything we have tried it on yet. It is a big tractor and it does a big job. I have owned Caterpillar-built machines now for about fifteen years and find they stand up best on the toughest of work. Our dealer service is also tops."

That's typical of other reports about the Turbocharged D9. In every way, it's a big machine for your biggest, toughest jobs. It packs plenty of power — 260 HP at the drawbar and 320 HP at the flywheel. Its turbocharger, driven by the engine exhaust, packs air into the engine according to engine load, not engine speed, for greater efficiency. With bulldozer it weighs 35 tons, yet is as easy to maneuver as smaller machines, with hydraulic boosters providing power for steering, braking and master clutch use. And it's easy to service — for example, oil clutch, torque converter, transmission and steering clutches each can be moved individually.

To match your job needs, the D9 is available with torque converter or direct drive with oil clutch. For complete information, see your Caterpillar Dealer, who's a source of efficient service and parts you can trust. Ask him to show you facts and figures proving the D9 can step up your production. Better still, name the date — he'll be glad to demonstrate!

Caterpillar Tractor Co., San Francisco, Calif.; Peoria, Ill., U. S. A.

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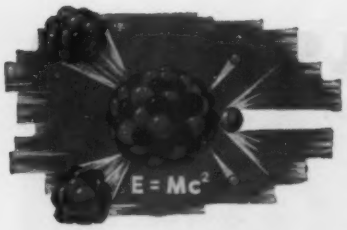
WANTED— THE HARD WORK



FISSION FACTS

Monthly Roundup of Mining News In the Atomic Energy Field

South African U_3O_8 Is Low Grade With Wide Cost Variations

South African uranium producers receive a comparable price per pound for their uranium than do United States producers. This fact is deduced by MINING WORLD in a special report from Johannesburg, Union of South Africa. While the total price per pound of uranium oxide paid by the Joint Atomic Development Board (United States and British governments) and the treatment costs remain secret, enough data are now available to reach this conclusion.

The special accompanying table lists uranium ore grades, tons of ore milled, profits per ton of ore, and profits per pound of uranium oxide for 20 major South African gold-uranium mines.

Uranium oxide content of the ore varied from a low of 0.172 pound per tons at Merruspruit OFS Gold to a high of 2.27 pounds at Luipaards Vlei Estate and Gold Mining Company, Limited. The lowest grade is lower than that of the Blind River district in Canada where millions of tons of uranium ore average between 2.4 and 3.5 pounds per ton. However, Blind River thicknesses are up to 20 feet in comparison to an average of about 40 inches in South Africa. United States ore reserves average very close to 5.0 pounds of uranium oxide per ton.

The average yield column is notably lower than the grade of blocked out reserves column. This is natural as it includes dilution from mining despite the fact that some mines sort waste on surface.

The total profit from both gold and uranium varies from a loss of $0.03 per ton to a profit of $22.60 per ton. Declared profits from uranium alone vary from $0.25 to $8.30 per ton. The declared uranium profits per pound of uranium recovered vary from $3.32 to $10.70.

It is interesting to note that several mines showed a greater profit per ton for uranium than they did for combined gold and uranium. Freddies Consolidated Mines Limited is an example where the combined gold plus uranium income was a $0.03 per ton loss, but the uranium profit was $1.06 per ton. Obviously those mines (for certain ores) are actually uranium mines with gold merely a byproduct. It is interesting to see that 10 of the 26 companies earned a profit per pound of uranium recovered between $6.00 and $9.00 per pound. Also, that 14 had a profit between $6.00 and $10.00 per pound. This might indicate that contracts had been worked out whereby profits had been guaranteed within this range and that each individual company had a chance to improve the base profit guarantee by better metallurgy or higher tonnages.

In many instances it is noteworthy that the cheapest uranium production comes from the lower grade gold ores which have a higher uranium content but are not economic to mine for gold alone. In order to show the true uranium profit the uranium costs should include the loss sustained in mining and milling gold prior to the delivery of the gold tailing to the uranium plant.

First Report on Uranium Prices, Uranium Profits, Uranium Ore Grades and Reserves for 26 Major South African Gold-Uranium Mines[1]

	ORE RESERVES										
Mining Company	*Blocked Out Tons*	*Grade Pounds U_3O_8 Per Ton*	*Width Inches*	*Total Tonnage Treated Final 1956 Quarter*	*Average Yield Pounds U_3O_8 Per Ton Ore*	*Extraction Percent*	*Total Gold and U_3O_8 Profit Per Ton Treated*	*Declared U_3O_8 Profit Per Ton*	*Declared U_3O_8 Profit Per Pound U_3O_8 Recovered*	*Typical Uranium Ore Faces*	
										Pounds U_3O_8 Per Ton	*Width Inches*
West Rand Consolidated Mines Limited	3,384,000	1.294	33.0	678,000	0.449	N.A.[2]	$2.60	$3.94	$8.65	2.694	22.8
Stilfontein Gold Mining Company, Ltd.	4,286,000	0.304	38.1	278,000	0.273	N.A.[2]	9.14	1.77	6.45	3.75	4.5
Randfontein Estates Gold Mining Company	1,710,000	1.2	33	624,000	0.574	90.3	14.25	6.14	10.70	3.1	20
Freddies Consolidated Mines, Ltd.	1,193,000	0.38	40	172,000	0.274	86.4	0.03 (loss)	1.06	3.46	4.4	6
East Champ d'Or Gold Mining Co., Ltd.	161,000	1.0	31	34,500	0.757	90.2	1.66	8.30	11.00	2.4	17
Loraine Gold Mines, Ltd.	1,101,800	0.215	44.41	180,000	0.123	86.4	0.41	0.77	6.28	4.04	4.33
President Brand Gold Mining Co., Ltd.	2,501,000	0.346	48.15	180,500	0.285	86.4	19.70	1.93	6.75	3.72	5.93
President Steyn Gold Mining Co., Ltd.	3,102,000	0.355	47.12	263,000	0.275	86.4	8.40	1.81	6.58	1.38	13.98
Daggafontein Mines, Ltd. (slimes)	4,587,500 3,000,000	0.435 0.4	46.9	1,019,442[3]	0.124	82.5	3.22	0.98	7.93	0.65	19.09
Welkom Gold Mining Co., Ltd.	2,355,000	0.229	49.91	—	—	—	—	—	—	2.83	9.03
Vaal Reefs Exploration and Mining Co., Ltd.	1,480,000	0.766	38.9	161,000	0.562	85.7	10.48	4.16	7.22	5.13	8.65
Western Reefs Exploration and Development Co., Ltd. (slimes)	4,562,300 9,050,000	0.441 0.34	44.74	980,116[3]	0.164	84.9	1.71	1.21	7.36	2.58	14.78
Doornfontein Gold Mining Company, Ltd.	1,246,000	0.18	40	232,500	0.068	N.A.[2]	5.68	0.25	3.54	0.36	40
West Driefontein Gold Mining Company, Ltd.	1,438,000	0.21	42.1	225,000	0,098	N.A.[2]	22.60	0.87	8.85	0.30	42.1
Luipaards Vlei Estate and Gold Mining Co., Ltd.	644,000	2.27	36.2	244,000	0.725	91.1	2.75	2.40	3.32	2.32	36.1
Vogelstruisbult Gold Mining Areas, Ltd.[4]	1,098,000	0.54	42.9	330,000	0.184	N.A.[2]	3.04	1.28	6.96	0.53	46.6
Harmony Gold Mining Company, Ltd.	1,846,000	0.644	54.5	251,989[3]	0.442	80.1	8.33	3.09	7.00	1.156	29

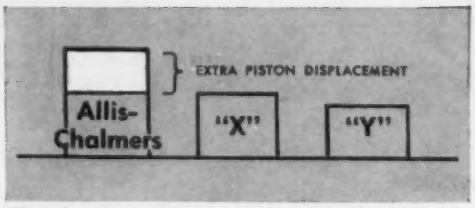
Table and text continued on page 11

ALLIS-CHALMERS DIESELS OFFER

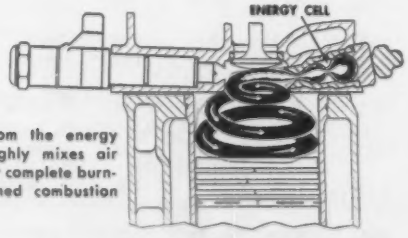
more USABLE power for your equipment

more PROFIT for you

You have a new kind of engine performance with Allis-Chalmers diesels. Their big piston displacement gives you greater reserve power, higher usable torque in the normal operating range. Their unique "follow-through" combustion results in highly efficient burning — builds up compression pressure slowly, sustains it over a longer period. Result: more *usable* power.



Allis-Chalmers' big piston displacement gives you extra usable power.



A blast from the energy cell thoroughly mixes air and fuel for complete burning, sustained combustion pressures.

Equipment must be *working* to be *earning* — Allis-Chalmers engines earn more because they are on the job working more. Rugged, simple construction, with fewer parts, means a minimum of maintenance. Get the complete story of why Allis-Chalmers engines give you more usable power, more profit. See your Allis-Chalmers engine dealer.

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West Rand Consolidated Mines Limited was the first by-product uranium gold mine in South Africa. Its operations and uranium plant have been fully described in MINING WORLD. (See February 1951, page 28, and March 1951, page 37; also see December 1952, page 36.) West Rand was first in production because of the high (1.294 pounds per ton) uranium content in certain of its gold ore. Of the 20 mines listed only one has a higher uranium content. Announced profit was $8.65 per pound and $3.94 per ton. Gold production must have been at a loss for certain ores because total profit was only $2.60 per ton. However, it must be remembered that several mines have concentrated production in high uranium areas with low gold rather than mine higher straight gold ore. It must also be considered that several companies treat both newly mined ore and accumulated tailings for uranium recovery. All reserves indicated are solely for uranium-bearing reefs. The total tonnage treated column is largely ore milled primarily for gold.

It is important to realize, in evaluating information on the South African program, that four of the mines—Randfontein, East Champ d'Or, Luipaards Vlei, and West Rand Consolidated—are primarily producers of uranium and that the revenue from gold is insufficient to cover the costs of mining, grinding, and gold recovery. Losses suffered on gold are therefore a direct charge to uranium production and are as much a cost of production as any other cost factor. Also note that neither Vaal Reefs' nor Hartebeestfontein's figures have taken amortization into consideration.

The total pounds of uranium available in these reserves are not as high as many had thought. In other words, South African uranium is not going to create a great flood on the market now, or in the future.

Greatest single reserve is 3,780,000 pounds in the 9,050,000 tons of accumulated tailings at Western Reefs Exploration and Development Company Limited. Contrast this with the more than 200,000,000 pounds in Ambrosia Lake, New Mexico; also with the indicated 40,000,000-pound-plus reserves of Homestake-Sabre-Pinon Partners in Ambrosia Lake.

All these facts point out that South African uranium is high cost uranium—some very high cost. It appears that much of it will be high cost after 1962, even if forced to compete on the world market. But don't forget that the South African Atomic Energy Board has long time contracts with the United States government which will keep them in operation. United States uranium producers believe many African contracts extend past 1962 at higher rates than the $8.00 per pound concentrate price announced by the United States Atomic Energy Commission for that period for domestic mills.

Another thing to consider that some of the South African uranium is also low cost. In fact very low cost. So low cost that with uranium plant facilities amortized by 1962 that costs will continue low. Of course the United States milling contracts provide for amortization of milling facilities also.

Total uranium production in South Africa in 1956 was 8,449,259 pounds of U_3O_8. In 1955 it was 3,647,112 pounds. United States production in 1956 was 12,000,000 pounds.

	ORE RESERVES									Typical Uranium Ore Faces	
Mining Company	*Blocked Out Tons*	*Grade Pounds U_3O_8 Per Tons*	*Width Inches*	*Total Tonnage Treated Final 1956 Quarter*	*Average Yield Pounds U_3O_8 Per Ton Ore*	*Extraction Percent*	*Total Gold and U_3O_8 Profit Per Ton Treated*	*Declared U_3O_8 Profit Per Ton*	*Declared U_3O_8 Profit Per Pound U_3O_8 Recovered*	*Pounds U_3O_8 Per Ton*	*Width Inches*
Blyvooruitzicht Gold Mining Co., Ltd.	6,865,000	0.433	46.2	468,001[3]	0.29	72.5	9.40	1.87	6.32	3.88	8
Klerksdorp Consolidated Goldfields, Ltd.[5]	850,000	1.4	36	—	—	—	—	—	—	—	—
Buffelsfontein Gold Mining Company, Ltd.	—	—	—	—	—	—	—	—	—	0.859	36.7
Hartebeestfontein Gold Mining Company, Ltd.	1,682,200	0.744	45.0	255,541	0.509	86.27	10.62	3.35	6.59	2.486	14.0
(slimes)	734,900	0.778	—	—	—	—	—	—	—	—	—
Merriespruit (Orange Free State) Gold Mining Co., Ltd.	962,000	0.172	44.34	205,400	0.061	35.67	—	—	—	0.438	30.4
Virginia Orange Free State Gold Mining Co., Ltd.	1,588,000	0.639	55.0	391,697	0.465	79.52	4.90	3.15	6.75	1.196	34.2
(slimes)	271,600	0.380	—								
New Klerksdorp Gold Estates Ltd.	250,000	0.348	47.9	60,566	0.291	79.38	0.42	1.25	4.27	0.705	42.3
(slimes)	272,000	0.400	—	—	—	—	—	—	—	—	—
Ellaton Gold Mining Co., Ltd.	576,000	0.548	44.0	97,000	0.273	N.A.	2.74	1.17	4.24	1.864	30.94
Dominion Reefs (Klerksdorp) Ltd.	202,500	2.21	35.0	119,670	0.904	N.A.	4.48	N.A.	5.06	2.25	31.0
(slimes)	2,630,000	0.96	—								

1. The ore reserves are the latest available figures and represent the tonnage in the principal uranium-bearing reefs.
2. Not available. 3. Including slimes.
4. Vogelstruisbult reserves are plus or minus 330,000 tons including 30,000 tons of concentrate averaging about 0.94 pounds of U_3O_8 per ton.
5. Klerksdorp Consolidated is a prospecting company not yet a declared uranium producer.
6. Dominion Reefs is classified as a base metal producer, while all others are classed as gold mines with uranium byproduct.
Note. With South African Pound at $2.80.

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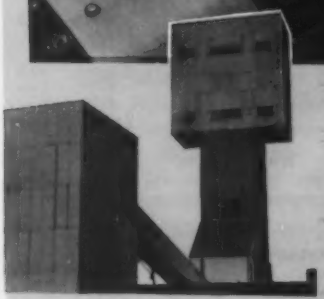
FIRST MULTI-ROPE FRICTION HOISTS

IN U. S. BRING MAJOR SAVINGS IN INSTALLATION AND OPERATING COSTS



The tower-mounted ASEA multi-rope friction-drive hoists pictured here were installed by Cleveland Cliffs Iron Ore Company in the Cliffs Shaft Mine, Ishpeming, Mich. The installation consists of two ore hoists and one service hoist mounted in one head frame. The skip load is 15 tons, maximum speed 2000 ft/min; maximum depth 4000 feet; pushbutton controls.

Pioneering in the design and development of multi-rope friction-drive hoists, ASEA offers the advantage of its engineering background and wide experience in this new concept in mine hoisting. 14 ASEA mine hoists are on order for the U. S. and Canada—7 now operating.

Outstanding advantages of ASEA friction drive mine hoists

SAFETY

1. Several parallel ropes are used instead of a single rope.
2. Safety wedges on shaft guides assure rope slip and prevent overwind.

ROPE WEAR

1. Less wear due to elimination of fleet angle, absence of S-bends, and elimination of cross-overs in multilayer practice.

GUIDE WEAR

1. Less wear because ropes are arranged L.H. and R.H. lay so as to counteract any tendency of the conveyance to twist.

SIZE AND COST OF HOISTING UNIT

1. Smaller diameter and narrow width of pulley give low unit weights and reduced inertia.
2. Compact size and low weight permits installation in headframe above shaft with gravity flow through ore preparation plant.
3. Above factors result in lower initial capital and operating cost.

POWER DEMANDS AND CONSUMPTION

1. These are lower—due to balancing weight of tail rope and the decreased inertia of rotating parts.
2. Peak demands of individual conveyances in multilevel operation can be offset automatically by electric control.

FLEXIBILITY

1. Friction drive pulley can be used as a single drum, single rope hoist for initial shaft sinking.
2. Independent operation of single hoists with counterweights permits hoisting from different levels concurrently.

Illustrated booklets on ASEA mine hoists are available upon request.

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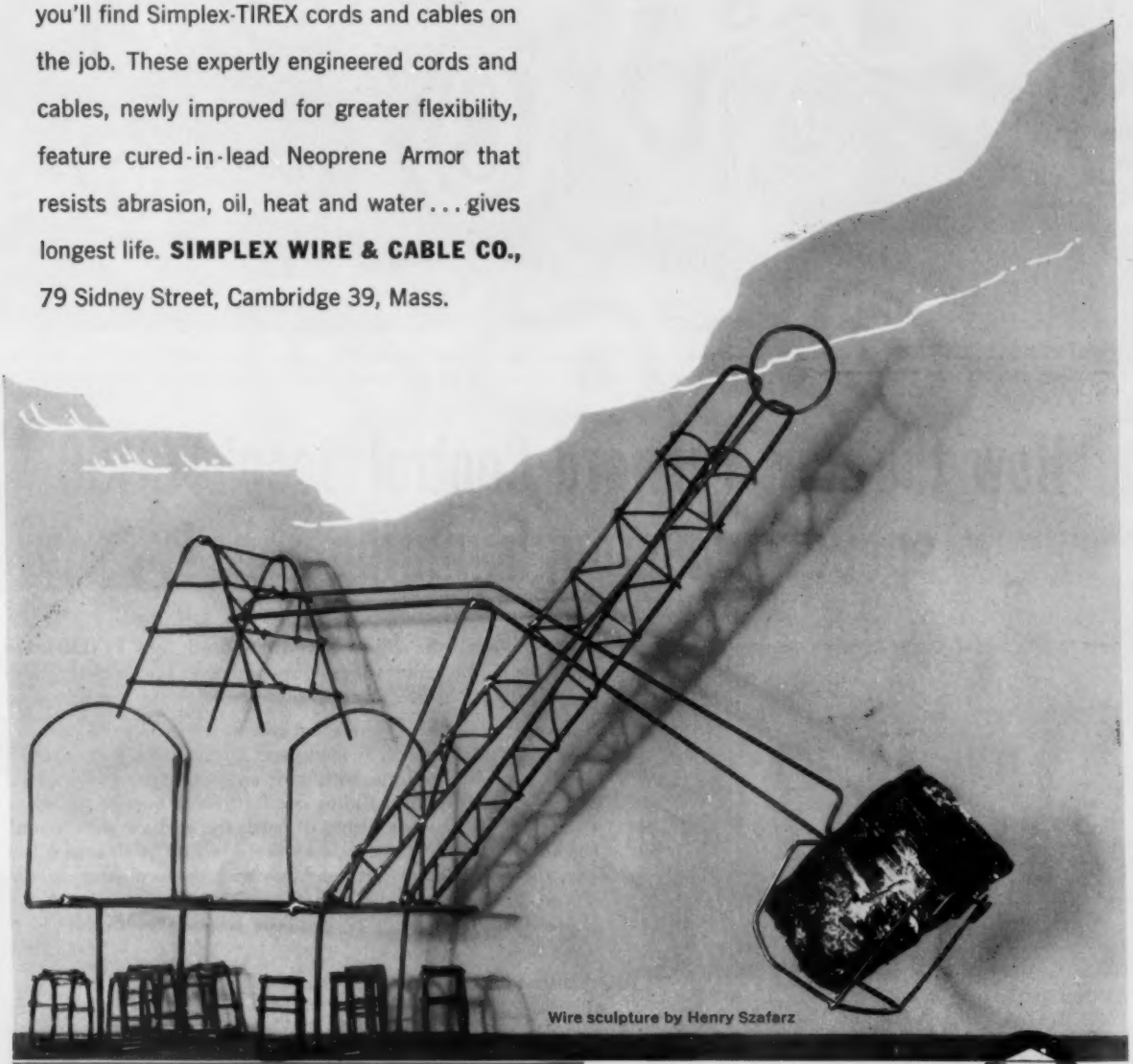
The effective use of power equipment is the very essence of successful mining operations. And everywhere that power is used in mines, you'll find Simplex-TIREX cords and cables on the job. These expertly engineered cords and cables, newly improved for greater flexibility, feature cured-in-lead Neoprene Armor that resists abrasion, oil, heat and water . . . gives longest life. **SIMPLEX WIRE & CABLE CO.,** 79 Sidney Street, Cambridge 39, Mass.



Wire sculpture by Henry Szafarz

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New Forward Control Design provides more space because the engine is behind you. It puts a 74" pickup box on 81" wheelbase—record-breaking cargo space per inch of wheelbase. This efficient design makes maneuvering through rough terrain faster and safer.

How the New Forward Control 'Jeep' FC-150 speeds your tough mining jobs!

All-Wheel Traction. With the extra traction of its 4-wheel drive, the FC-150 travels through mud, sand, soft earth, and climbs hills as steep as 65%... in good weather or bad. Yet, it shifts easily into 2-wheel drive for highway travel at top legal speeds.

On job after job, the all-new Forward Control 'Jeep' FC-150 keeps mining jobs on schedule with savings of time and manpower. That's because it's made to order for every phase of mining operations.

Here's a 4-wheel drive truck that gives you maximum cargo space on minimum wheelbase. It maneuvers through the heavy, rough going of mining projects, with crew and equipment, where ordinary trucks call it quits. Riding comfort!—you have to test drive it to believe it! There's plenty of head, leg, and shoulder room! The all-new Safety-View cab lets you see terrain as close as 6 feet from the front bumper. It combines with the new wrap-around windshield—largest in the FC-150 weight class—for up to 200% greater forward visibility. With power take-off, the FC-150 operates a variety of special equipment from winches to portable drills.

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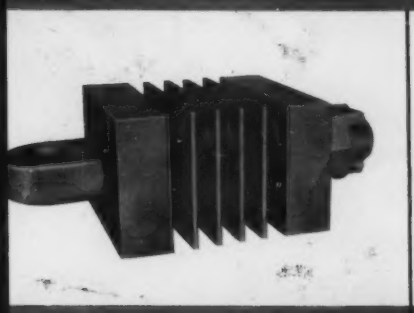
Still another large underground mine equips with **NATIONAL** devices



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WILLISON AUTOMATIC COUPLERS
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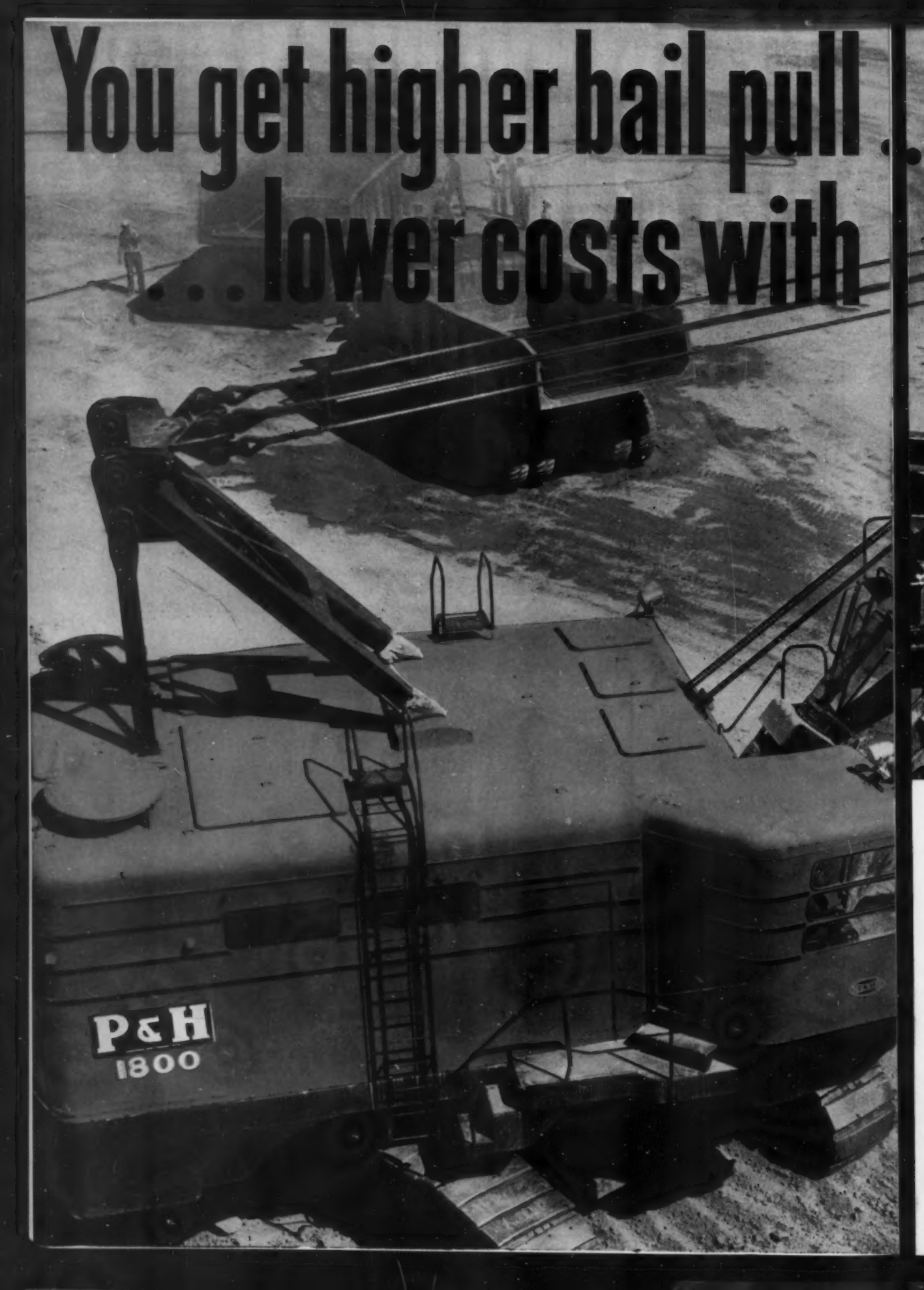
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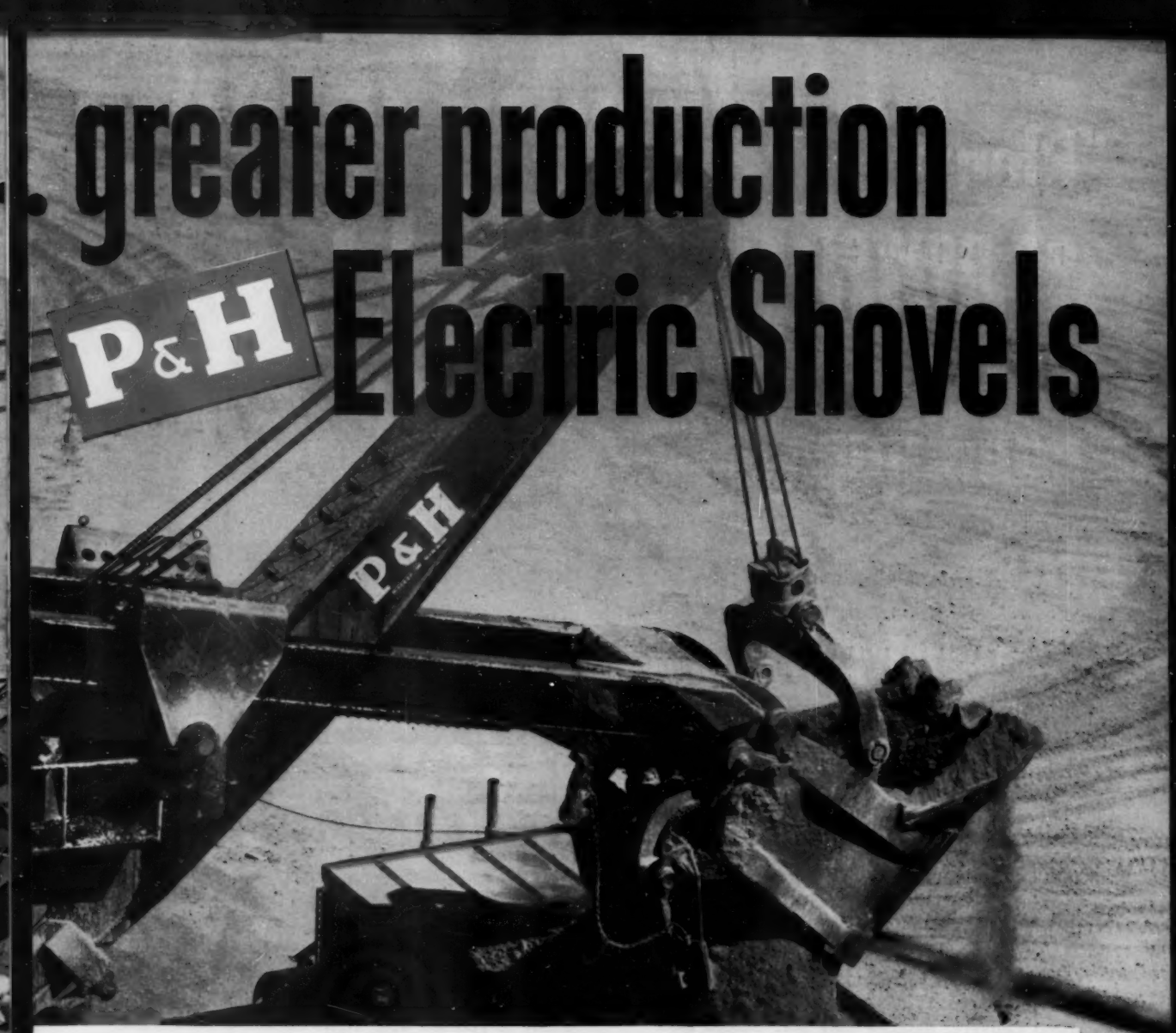

P&H scientific weight distribution gives greater stability permitting the use of higher line pull per cu. yd. of dipper capacity—resulting in greater production at lower cost.

For P&H has set the design standards for the electric shovel industry with these *exclusive features:* Magnetorque* and P&H Electronic Controls.

MAGNETORQUE . . . transmits power from the hoist motor to the dipper magnetically for faster action, and at the same time, eliminates shock and impact to the hoist gear train and motor. Response is immediate to varying load conditions.

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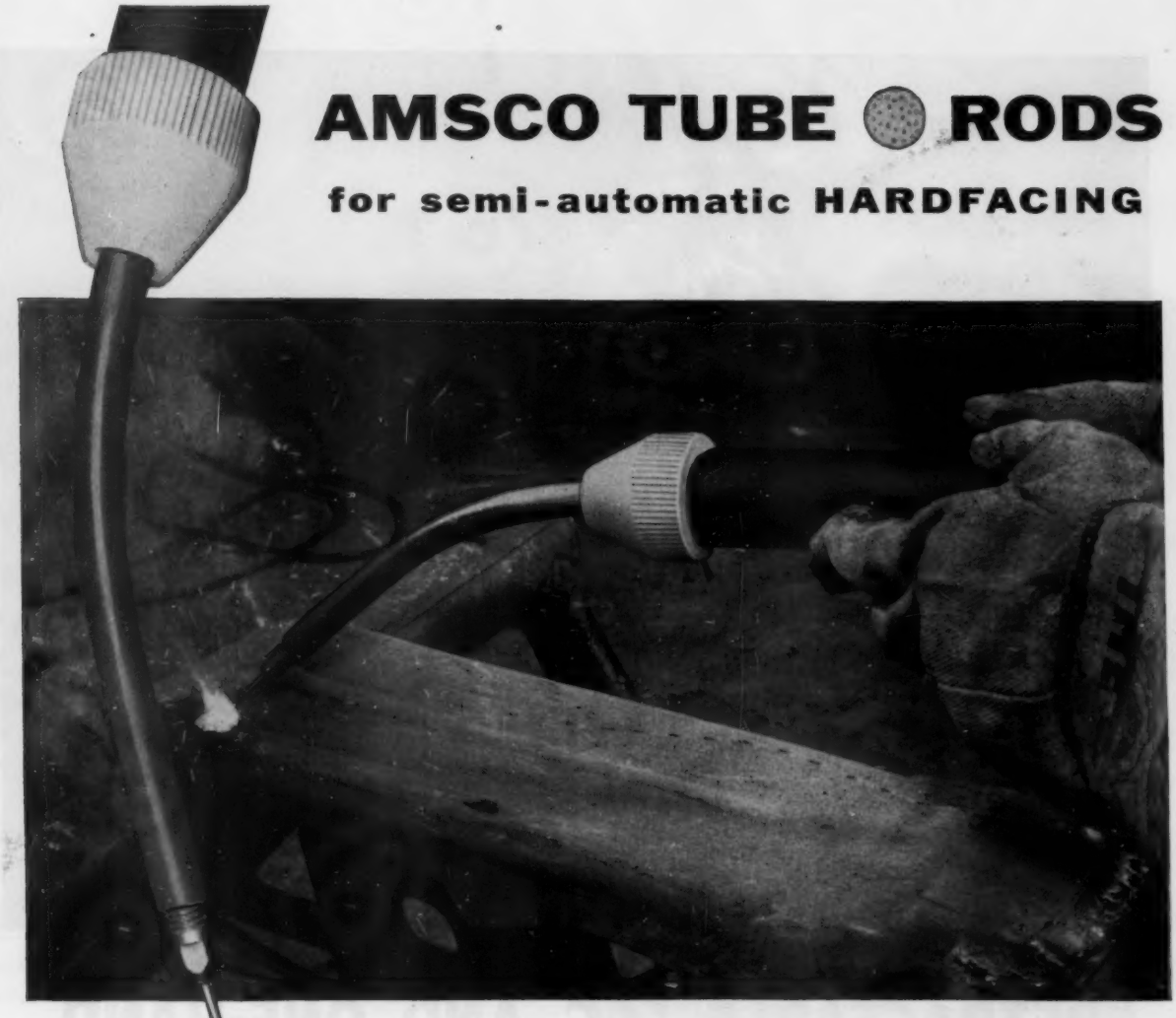
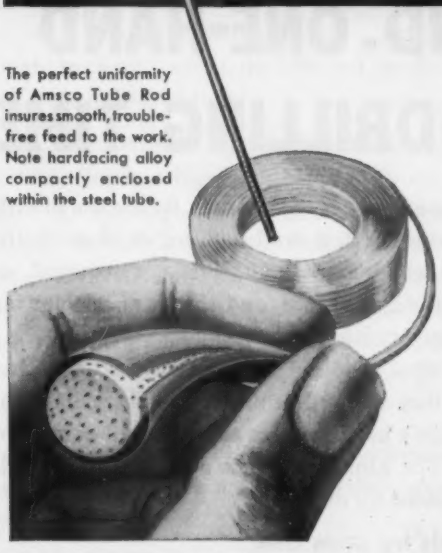


The perfect uniformity of Amsco Tube Rod insures smooth, trouble-free feed to the work. Note hardfacing alloy compactly enclosed within the steel tube.



Here are new, improved tube rods . . . *specially designed and engineered* for semi-automatic hardfacing! They have *proved* their speed, quality of weld and uniform deposit in actual use tests. In many cases, deposition rate has been increased up to 200% over other types of semi-automatic electrodes.

Amsco® Tube Rods are perfectly symmetrical, steel-shell wires, with the various alloys firmly enclosed and evenly distributed, for proper weld deposit. The steel shell is work-hardened to provide rods that will not deform or snarl during welding . . . that will run well in any semi-automatic welder. The rods are pre-lubricated, to insure constant and uninterrupted feeding to the work.

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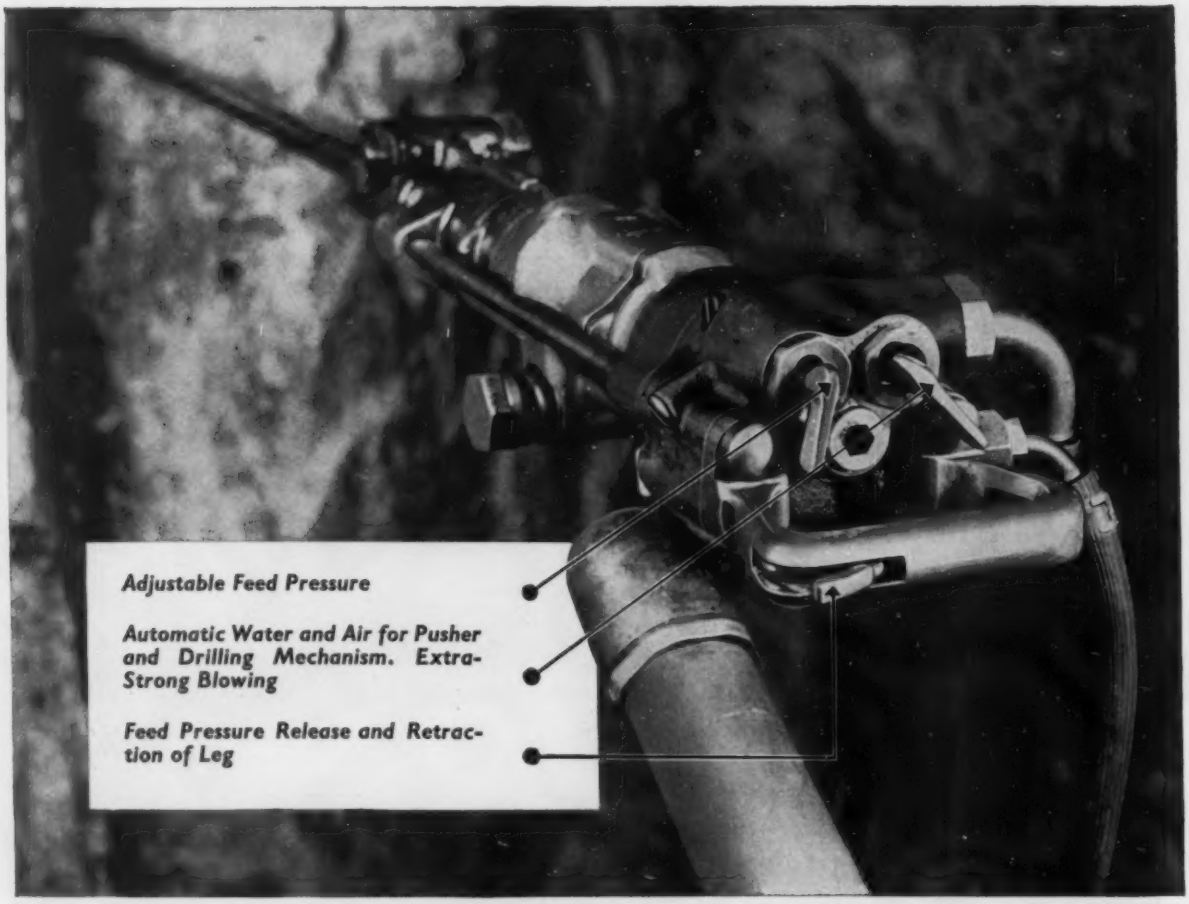
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The Atlas Copco Lion is the first drill to have all the valves which operate the drill under the control of one hand. *Full control without having to move the hand from the backhead!*

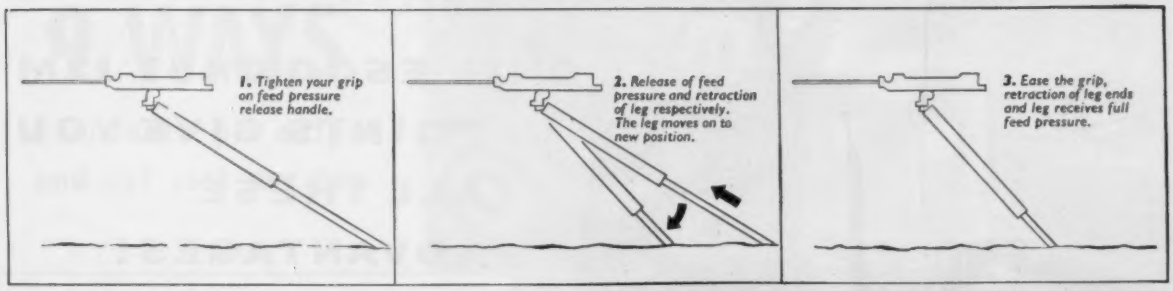
The valves are all easy to operate. By the use of only the fingertips the drill can be started or shut off, the feed can be adjusted to the pressure required, or retracted for an advance, and the extra air-blowing can be brought on to clean the holes.

All the control handles have been designed in such a way that they are well protected. While using them the operator's hand is never near the wall or roof of the drift. The Lion is the first pusher leg drill with controls placed for drifting.

Retractable leg saves time

When the leg has to be moved the feed pressure is easily released by squeezing the hand grip. By further pressure on the grip the leg retracts automatically.

Pusher leg moves forward with drill in full action


1. Tighten your grip on feed pressure release handle.
2. Release of feed pressure and retraction of leg respectively. The leg moves on to new position.
3. Ease the grip, retraction of leg ends and leg receives full feed pressure.

When the leg is in the new position suitable for continuous drilling, retraction stops and the feed pressure comes back by loosening the grip of the hand. *All this can be done while the drill is still running.*

This new idea of a retractable leg enables quicker repositioning of the leg and reduces the number of steel changes, thereby increasing footage per manshift. When drilling high holes it is now far easier to alter the position of the leg more frequently in order to maintain an optimal feed angle and feed pressure.

Packed with power for deep holes

The Lion has a drilling rate at least 30% higher than other rock drills of the same weight. Furthermore, it is designed so that it can maintain its high speed *even when drilling deep holes.* This means quickly drilled deep hole rounds and a faster, steadier advance. You'll also find that the Lion reduces *to a minimum* the gauge wear of the bits in abrasive rock. And owing to the ease with which the feed pressure is released and brought back into action, the Lion is a *handier* drill to work with in fissured rock.

Sandvik Coromant—the right steel for the Lion

All Atlas Copco drills—and this goes for the Lion—have been developed from the earliest stages with Sandvik Coromant tungsten-carbide-tipped integral steels and detachable bits. No drill or steel developed separately could ever give such equivalently high performances as this drilling combination. It is today the most widely used in the world, responsible for drilling more than one billion feet per year.

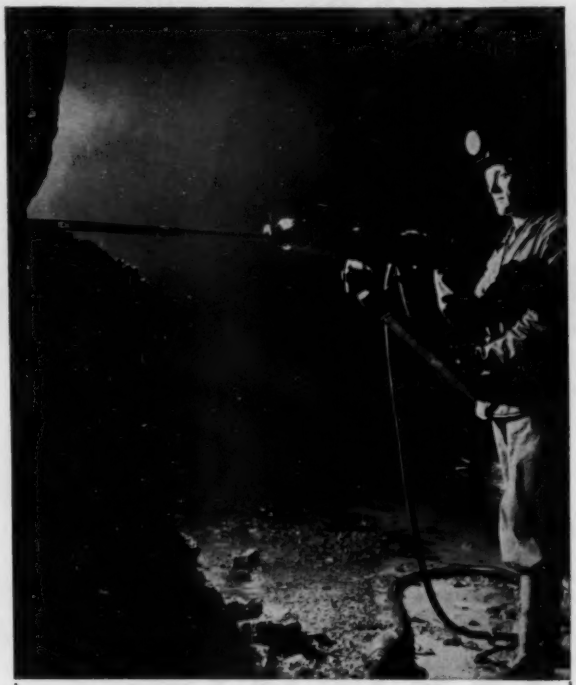
Free Demonstration! *Wire, 'phone or write* today *to any one of these offices and see the Atlas Copco Lion in action for yourself.*

U.S., Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California. Atlas Copco Eastern, Inc, P.O. Box 2568, Paterson 25, N.J.

CANADA, Atlas Copco Canada Ltd., Montreal Airport P.Q.

MEXICO, Atlas Copco Mexicana S.A., Apartado 56, Torreon, Coahuila.

The ATLAS COPCO GROUP puts compressed air to work for the world. It is the largest group of companies specializing solely in the development and manufacture of compressed air equipment. It embraces Atlas Copco companies or agents manufacturing or selling and servicing Atlas Copco equipment in ninety countries throughout the world.

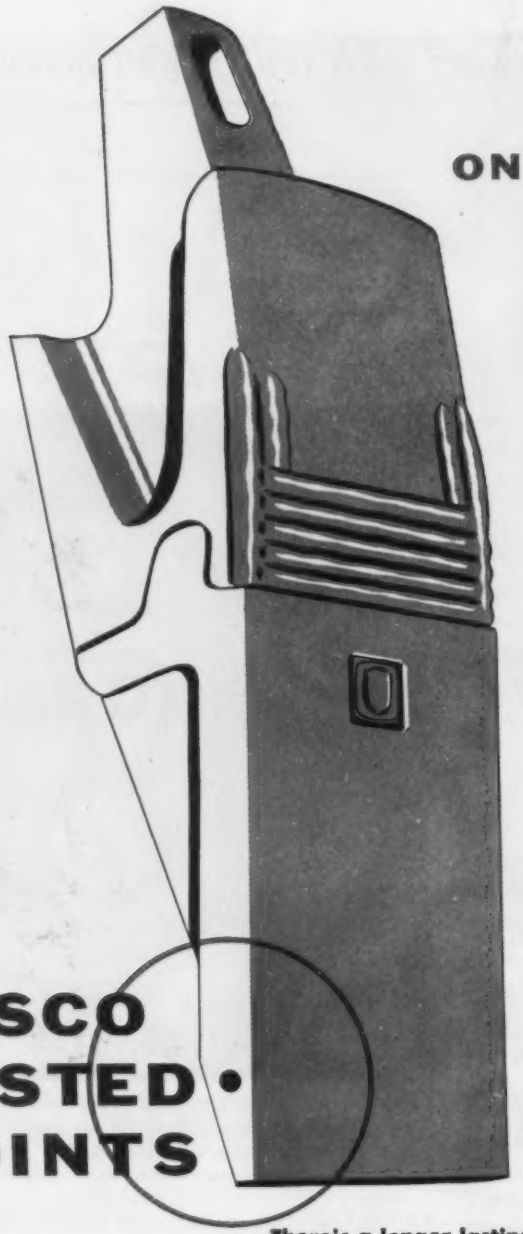


Without changing the grip of the hand the driller can easily position and control the machine, saving time and reducing fatigue.

Atlas Copco

DS51

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment



ESCO TESTED • POINTS

ONLY ESCO CAST 12M POINTS GIVE YOU ALL THESE ADVANTAGES!

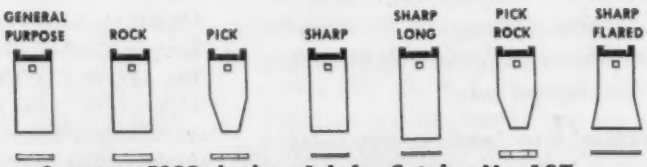
1 Abrasion-resistant, shock resistant 12M castings that put the *extra metal* where it counts the most—*at the wear points.*

2 Engineered design that starts sharp, wears sharp and lasts longer, yet can be replaced almost instantly to reduce downtime.

3 Individual Brinell Testing of every point to assure the right degree of abrasion-resistant hardness at the tip and shock-absorption in the body.

4 A choice of seven Point Shapes to fit your equipment to the job regardless of your digging condition.

There's a longer lasting ESCO Tested Point and Adapter to fit every digging tool.



See your ESCO dealer. Ask for Catalog No. 187.

ESCO ELECTRIC STEEL FOUNDRY COMPANY

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Offices in Most Principal Cities
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IN CANADA ESCO LIMITED

Moving fast, this 123 hp "550" keeps pit floor clean, blades off loose dirt and rocks. Smooth access saves wear on haulers' tires. Regular clean-up, improved drainage, prevents dirt and refuse from weathering into levels of pit floor.

9 WAYS

to increase pit output and cut cost per ton

You may think of your grader simply as a maintenance tool. But in the hands of a good operator, a versatile, modern high-speed grader actually steps up mine and quarry production, and cuts operating costs. Check these 9 big ways increased grader capacity can boost profits.

1 Regular, more frequent maintenance of haul roads—smooth roads speed hauling, save tire wear, cut hauler down-time, improve safety.

2 Quick clean-up after blast—grader provides a fast, inexpensive way to move scattered fragments back against toe—thus protecting men, machinery, tires and other equipment working around pit, speeding up all pit operations.

3 Clean pit floors—regular routine of maintaining wide, clean traffic-ways that make all areas of pit or quarry quickly accessible, pays off. Equipment can always travel to any assignment by shortest route. Regular clean-up, improved drainage, prevents dirt and refuse from weathering into ore or coal below floor.

4 Maintain good housekeeping around plant—you need ample grader capacity to keep roads, runways, working areas around plant neat, clean, and workable at all times. Grader quickly and efficiently levels or removes the occasional spill left by heaped trucks...from around grizzlies, conveyors, trestles. A clean plant area speeds mobile equipment operation, reduces dust.

5 Keep stockpile toes pushed in—weather and loading operations result in spread of toes around stockpile. This limits working space, wastes stored material. Also, working thinly-spread toes down-grades material, increases loading cost.

6 Keep dumps smoothly spread and level—regular grader service can spread dumped material clear over edge. Offset blade reaches far out beyond wheels. A smooth, level, dry, dump speeds both hauling and dumping, cuts equipment costs. Grader can easily smooth haul road as it travels to and from the dump.

7 Clean ore benches of washed-down dirt—every rain washes dirt into upper benches, lowers quality of mined material. Prompt grader service halts "wash", provides planned drainage, piles washed-in material for easy removal by scraper or truck.

8 Assist exploration teams—a modern grader can build a well-graded and drained roadway in a matter of hours...speeds exploration work by maintaining good roads for hauling men and equipment.

9 Keep drainage open—with just a few hours work per week, a modern grader will keep ditches clean ...provide fast run-off, preventing seepage of dirty water into pit bed. Planned maintenance eliminates erosion of haul roads, keeps trucks and shovels operating on dry footing.

Check capacity of your present graders

It will pay you to re-assess the role and capacity of your present graders. If your machines are more than a few years old, you will probably realize a substantial increase in grader productivity by replacement with modern, fast, powerful, big-capacity graders. Call or write for full information on Adams heavy-duty graders. Six models: 190, 150, 123, 104, 80, and 60 hp. Choice of GM or Cummins engines on 5 larger models.

This 150 hp Adams 660 grades haul roads, at speeds to 6.5 mph, in 4th gear. Unit smooths surface for high-speed movement of production haulers. Travel speeds to 26 mph.

Adams — Trademark AG-1352-M-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

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Where quality is a habit

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PROJECT – PROCESS ENGINEERS, DESIGNERS, DRAFTSMEN Experienced in Smelter & Mill Layout, Process Piping, Materials Handling, Structural Design, Electrical Design.

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- Ideal working conditions, liberal company benefits, and good salaries.

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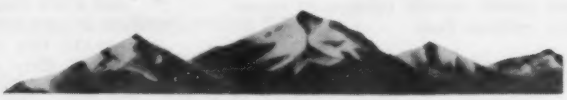


ESTABLISHED 1885

"Obtained excellent performance"

hauling blasted limestone to supply Argentine cement factory

At an important limestone quarry in Yocsina, Cordoba Province, Argentina, three Model D Tournapull Rear-Dumps work all the year around hauling blasted limestone rock to crushers. Machines are owned and operated by **"Corcemar" Corporacion, Cementera Argentina, S. A. of Cordoba.**

After limestone is crushed, it is hauled by trucks from the quarry at Yocsina to "Corcemar's" main cement factory, about 20 miles away.

396 tons in 5.3 hours

Rear-Dumps hauled the blasted limestone about 1,100 feet uphill to the stone crushers. These Tournapulls, full loaded, regularly traveled the haul route in 3rd or 4th gear up grades averaging 4.6%, at speeds of 12 to 20 miles per hour.

On these 2,200-foot cycles, each D Tournapull delivered 400 short tons of limestone during an 8-hour shift, although about ⅓ of the working time was spent in waiting for other equipment. Individual Tournapull loads averaged 9½ short tons on this operation, according to the engineer speaking for "Corcemar" Corporacion.

Tournapulls were working at reduced efficiency when this job was visited, because difficulties in hauling away crushed limestone made it impossible for crushers to operate at full capacity. Upon completion of a new storage bin, however, the three Tournapulls' increased speed and production can be fully applied to keep crushers supplied.

Impressed by this production, Ingenierio Blanc comments that the company has "obtained excellent performance from these Tournapull Rear-Dumps."

675 hours of use; no downtime

Accurate maintenance records were kept while the three machines worked respectively 166, 254, and 255 hours. During this period, none of the machines experienced any downtime at all.

Why not learn more about what the power, speed, and mechanical efficiency of Tournapull Rear-Dumps can accomplish in *your* materials-handling work? Write us for owner-verified production figures on the size Rear-Dump best suited to your needs. These LeTourneau-Westinghouse haulers are built in three sizes, 138, 208, and 293 hp, with 11, 22, and 35 short ton capacities . . . a size for every need.

Tournapull—Trademark Reg. U.S. Pat. Off. DR-1083-Q-b

Tournapull dumps a full load of limestone into one of the two stone crushers at this Yocsina quarry. Electric switch activates hoist motor. Body lifts quickly, swings low behind rear wheels to dump clean into the grizzly.

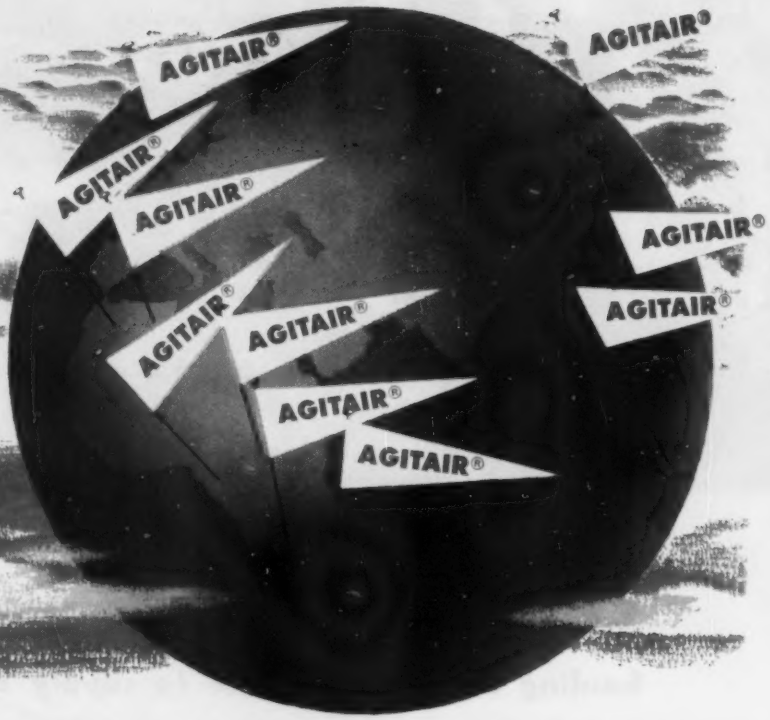
This D Tournapull Rear-Dump is heaped with 9½ short tons of blasted limestone by a 2-yard shovel, at a quarry in Cordoba Province, Argentina. Wide bowl opening of these Rear-Dumps provides an easy loading target.

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

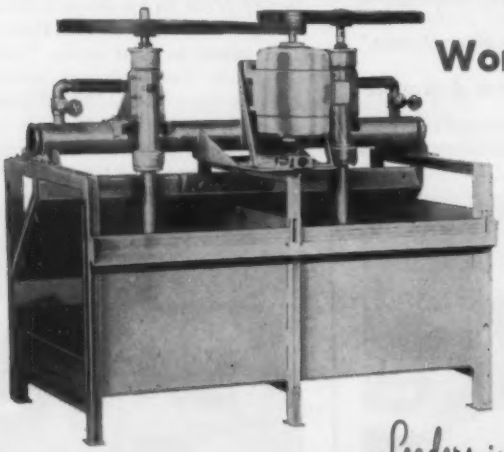
Where quality is a habit

AGITAIR® IS THERE!



You can choose with assurance..the Flotation Machine so successfully used in mining centers throughout the world

AGITAIR® Flotation is used in so many farflung places because it adapts so readily and efficiently to the varied problems of ore beneficiation encountered in the field of metallurgy. Flexibility is the key to its remarkable success. Its capacity to meet unusual demands is a challenge it welcomes. For complete information on AGITAIR® write for Bulletin A-55.



World Wide Consulting Service

Galigher consultants are at work, on assignment, in all parts of the globe, studying and solving problems in ore beneficiation. We are prepared to assist your staff in developing metallurgical procedures. Your inquiries will be carefully considered and promptly answered. Metallurgical Division Bulletin MET-056 outlines our various services.

Leaders in Experience and Service

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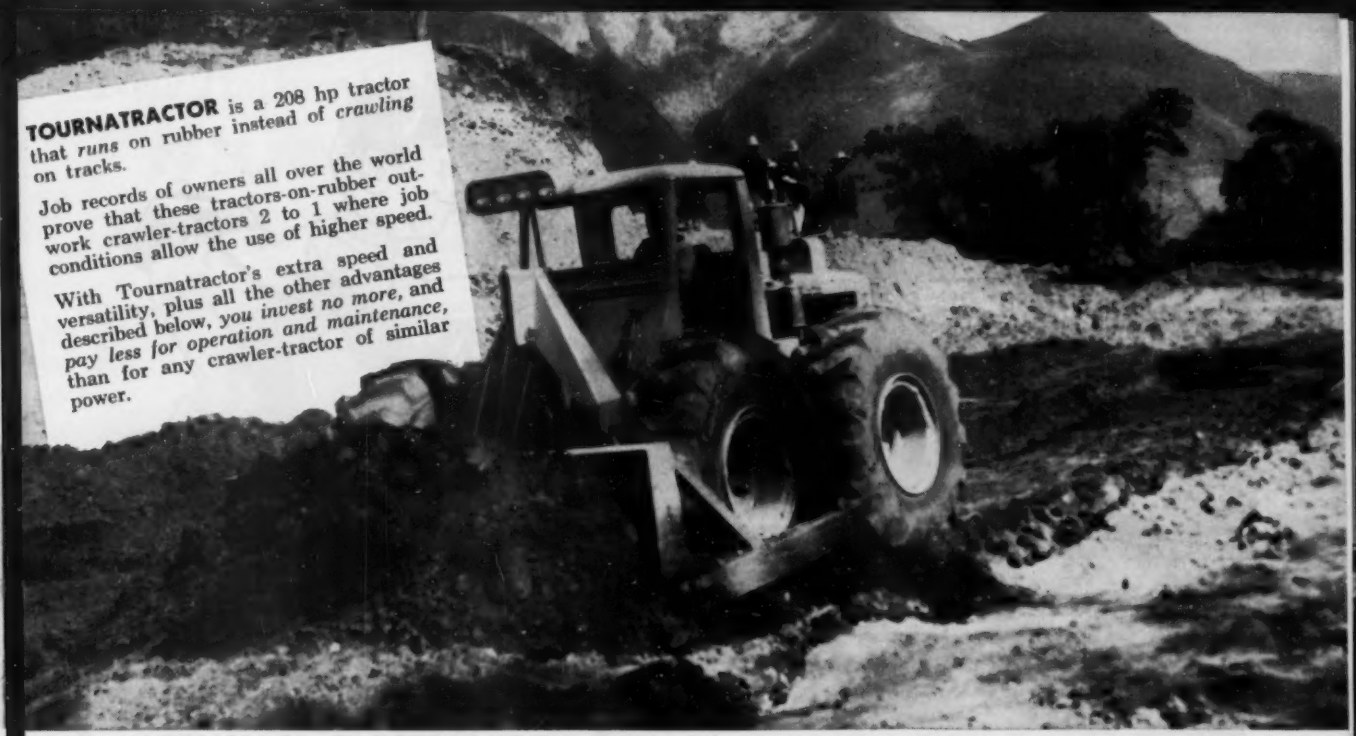
METALLURGICAL DIVISION · ENGINEERING SERVICE

A-5028

CONSULTATION • ORE TESTING • PLANT DESIGN

GALIGHER PRODUCTS: AGITAIR® Flotation Machine, VACSEAL Pump, Geary-Jennings Sampler, Acid-proof Sump Pump, Geary Reagent Feeder, Laboratory AGITAIR® Flotation Machine, Laboratory Pressure Filter, Laboratory Ball Mill, Rubber Lined and Covered Products, Plastic Fabrication.



TOURNATRACTOR is a 208 hp tractor that *runs* on rubber instead of *crawling* on tracks.

Job records of owners all over the world prove that these tractors-on-rubber outwork crawler-tractors 2 to 1 where job conditions allow the use of higher speed.

With Tournatractor's extra speed and versatility, plus all the other advantages described below, *you invest no more, and pay less for operation and maintenance,* than for any crawler-tractor of similar power.

Does speed fit your job?

Check these tractor advantages

19 mph forward . . . 8 in reverse

Tournatractor pulls, dozes, pushes at working speeds 2 to 3 times faster than crawler-tractors. You change gears instantly, waste no time shifting, move up to 8 mph in reverse. Torque converter provides the equivalent of an infinite number of gear ratios, automatically selected to balance load and torque.

Drives to work . . . anywhere

Tournatractor travels at speeds to 19 mph from job-to-job. Big, low-pressure tires drive anywhere without need for planking, trailers, loading or unloading.

Simple . . . less maintenance

Lubrication takes less than 5 minutes on Tournatractor, compared to 15 minutes or more on a crawler. Cleaning of tracks and fittings is eliminated. Self-cleaning tires last 2 to 3 times longer than tracks.

Anti-friction drive

208 hp diesel drives through dirt-sealed anti-friction bearings to free-rolling wheels. There is no grinding wear of sand, dirt, and mud as in driving with multi-part crawlers.

Provides emergency electric power

Flywheel-mounted generator produces electricity to operate blades and PCU, and in emergencies you can tap into this handy electric source for floodlights, power tools.

Easier to operate

Less jolt and jar on low-pressure rubber tires reduces stress and strain on both operator and machine. Simple electric controls permit operator to work faster, with less end-of-day fatigue.

Improves safety

Low center of gravity, all-around visibility, accessibility, and quick response of electric controls make Tournatractor exceptionally safe to operate. Its multi-disc air brakes have *four times* the braking surface of most big tractors and trucks.

Interchangeable equipment

Bulldozer, Angledozer, Root Rake, Snow Plow, Snow Wing, Push Block, Logging Winch, Tree Pusher, are also available.

Ask your LeTourneau-Westinghouse Distributor to help you analyze specific Tournatractor applications on your work. No obligation!

Tournatractor, Angledozer — Trademark Reg. U.S. Pat. Off. T-941-M-b

LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

the expert fisherman
has his rod custom-made
because he gets
something **EXTRA**

the profit-wise operator

BUYS TRAYLOR REDUCTION CRUSHERS for the same reason

Traylor Reduction Crushers are famous throughout the industry for the extra *production* and extra *profits* they put into mining operations. Traylor-made in ten sizes, with feed openings from 1½" to 22", Traylor Reduction Crushers provide capacities up to 590 tons per hour. For complete specifications write for Traylor Bulletin No. 11-120.

TRAYLOR ENGINEERING & MFG. CO.
932 MILL ST., ALLENTOWN, PA.
Sales Offices: New York—Chicago—San Francisco
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the experts agree . . . there's nothing like

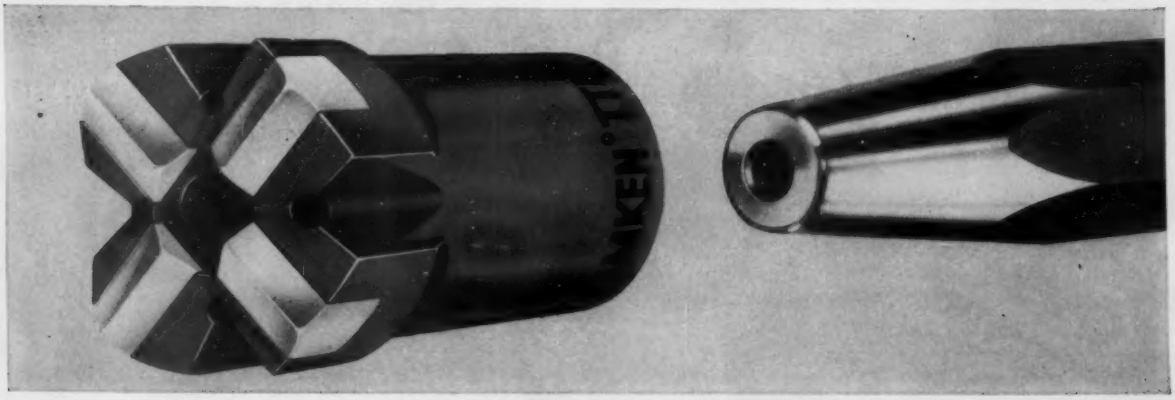
TRAYLOR-MADE

equipment for peak performance

A Traylor leads to greater profits

New Timken® bit for air-leg drills and light stoping...

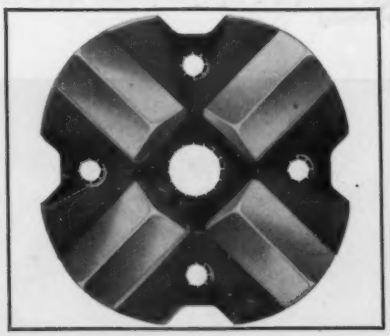
REMOVABLE for full steel life
TAPERED for more secure union



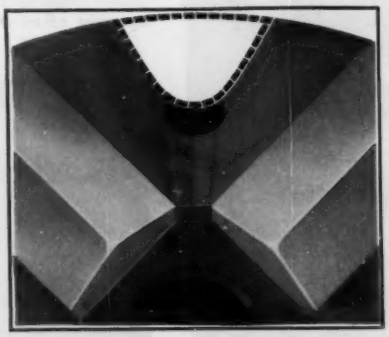
Here's how you can get lower cost per foot-of-hole with the new Timken® tapered socket bit. It's removable! Simply take off the old bit, put the new one on the same drill steel. No need to throw away the steel when the bit is used up. You can drill out the full life of every steel, cut your reconditioning costs to a minimum. And with its uniformly tapered socket the new Timken removable bit provides a more secure union than threads for feed-leg drills. Precision-made, the taper fits tight to the drill steel, reduces breakage, helps this new Timken bit lower your cost per foot-of-hole.

The bit body is made of special analysis Timken electric furnace fine alloy steel—giving you the finest in physical properties obtainable in a rock bit today. Special analysis carbides give the Timken tapered socket bit superior wear-resistance with added shock-resistance. It holds its gauge longer, drills faster, can be reconditioned many times. And it's available in three popular sizes: 1¼", 1⅜", and 1½". Send for free brochure today. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

TWO NEW FEATURES CLEAR CHIPS FASTER



NEW 5 FRONT HOLES direct water against face with jet-action velocity to wash away chips faster. Larger center hole has plug dropped deeper for freer cutting action, less drag on bit.



WIDER, DEEPER CLEARANCE works in unison with five front holes to remove chips speedily from cutting face. This faster chip flow speeds drilling, makes cutting more efficient, adds life to bit.

TIMKEN MULTI-USE BIT (left) with correct, controlled reconditioning gives lowest cost per foot-of-hole when full increments of steel are used. **NEW TIMKEN THREADED CARBIDE BIT** (right) for other tough jobs. Improved thread contact reduces breakage. New wear-resistant carbides add life.

TIMKEN REMOVABLE ROCK BITS

TRADE-MARK REG. U. S. PAT. OFF.

Before you buy any giant-sized
Measure TD-24 giant-sized

When you're 'dozing through rock and other materials, instant fingertip Hi-Lo shifting is a big cycle-speeder. And it cuts operator effort way down!

With full-time "live" power on both tracks, the TD-24 almost builds the road itself—hugging the mountain slope, giving added *operating ease, safety, and capacity!* That's another bonus from exclusive time-proven Planet-Power steering.

Try holding a 19-ton load on the blade with any other crawler this big—making a turn as this TD-24 is doing with both tracks pulling, while stockpiling coal with a special wing-type blade. The TD-24's operator can make "round-house," feathered, or pivot turns—with fingertip ease!

tractor advantages!

When you buy a big crawler look beyond sheer size and weight. You may be paying for enough extra "iron" to cause a startling jump in fuel and upkeep costs. So compare. Weigh bigness against provable working and earning capacity! Measure these giant-sized TD-24 advantages that have proven out over 8 years of on-the-job success!

Eliminates "dead-track drag!"

Does the giant you're considering steer with full-time "live" power and "live" traction on both tracks? TD-24 users by the thousands have proved that any crawler *this big* is obsolete without exclusive, time-proved Planet-Power steering advantages!

Planet-Power steering eliminates power-wasting, load-limiting "dead-track drag." Upgrade, downgrade, or on the level, you can smoothly turn a heavily-loaded TD-24—under positive control!

Does the big one you're looking at give cycle-speeding on-the-go shifting? The TD-24 does! And the exclusive two-speed planetary system teamed with a 4 speed synchromesh transmission —gives instant, stall-preventing and time-gaining Hi-Lo shifting, *without declutching.*

Does that big one you need have the genuine in-seat, seconds-fast, all-weather International gasoline conversion starting? Or the operating ease, power-transfer efficiency, and service-simplicity of the International Cerametallic-faced engine clutch? Or 8 practical speeds *forward and reverse?* Only the TD-24 has all these, plus dozens of other giant-sized advantages!

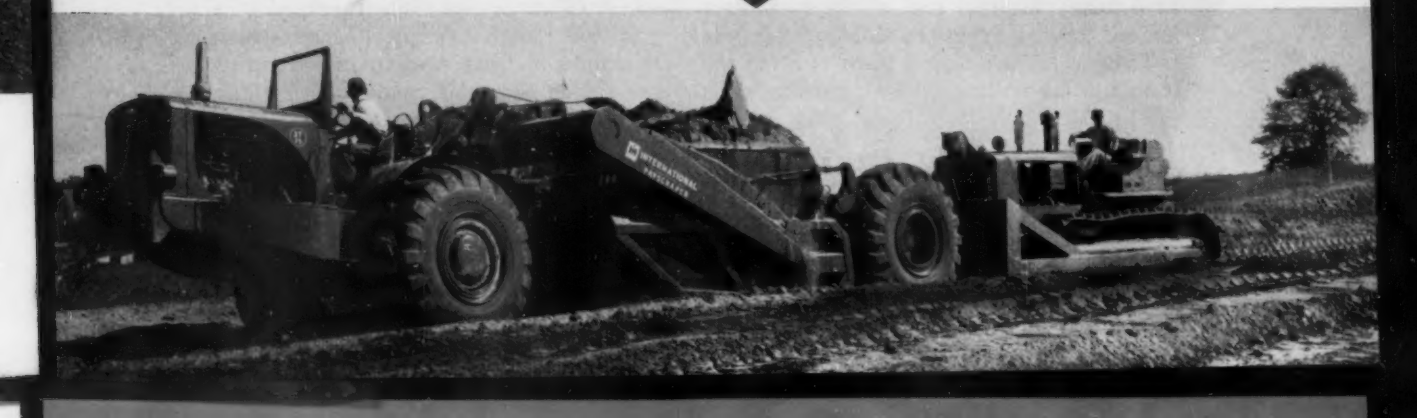
Prove to yourself the TD-24 beats all other giant-sized power—for *performance value*—for *big-scale ability to make you big money.* Ask your International Construction Equipment Distributor for a demonstration of a Gear-Drive or Torque-Converter TD-24!

INTERNATIONAL® CONSTRUCTION EQUIPMENT

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Side-Boom Tractors ... Self-Propelled Scrapers and Bottom-Dumps ... Crawler and Rubber-Tired Loaders ... Off-Highway Trucks ... Diesel and Carbureted Engines ... Motor Trucks

Heap-loading the sideboarded International "75" Payscraper in less than a minute proves the economy and efficiency of the TD-24 as a "pusher."



(Illustration from Agricola's De Re Metallica (1621)

All ore processing was difficult 400 years ago

There was a time when the grinding in an ore preparation plant consisted of a man with a hammer—like the one shown here, equipped with heavy leggings and gloves to protect himself against flying ore chips.

Today's ore processing plant is a far cry from this. It utilizes efficient grinding mills that turn out many tons of processed ore every day—mills which so often use CF&I Grinding Balls and Rods. CF&I Grinding Balls and Rods are always made from special analysis steel that has the ideal balance between toughness and hardness to assure optimum grinding ability and maximum wearability.

THE COLORADO FUEL AND IRON CORPORATION

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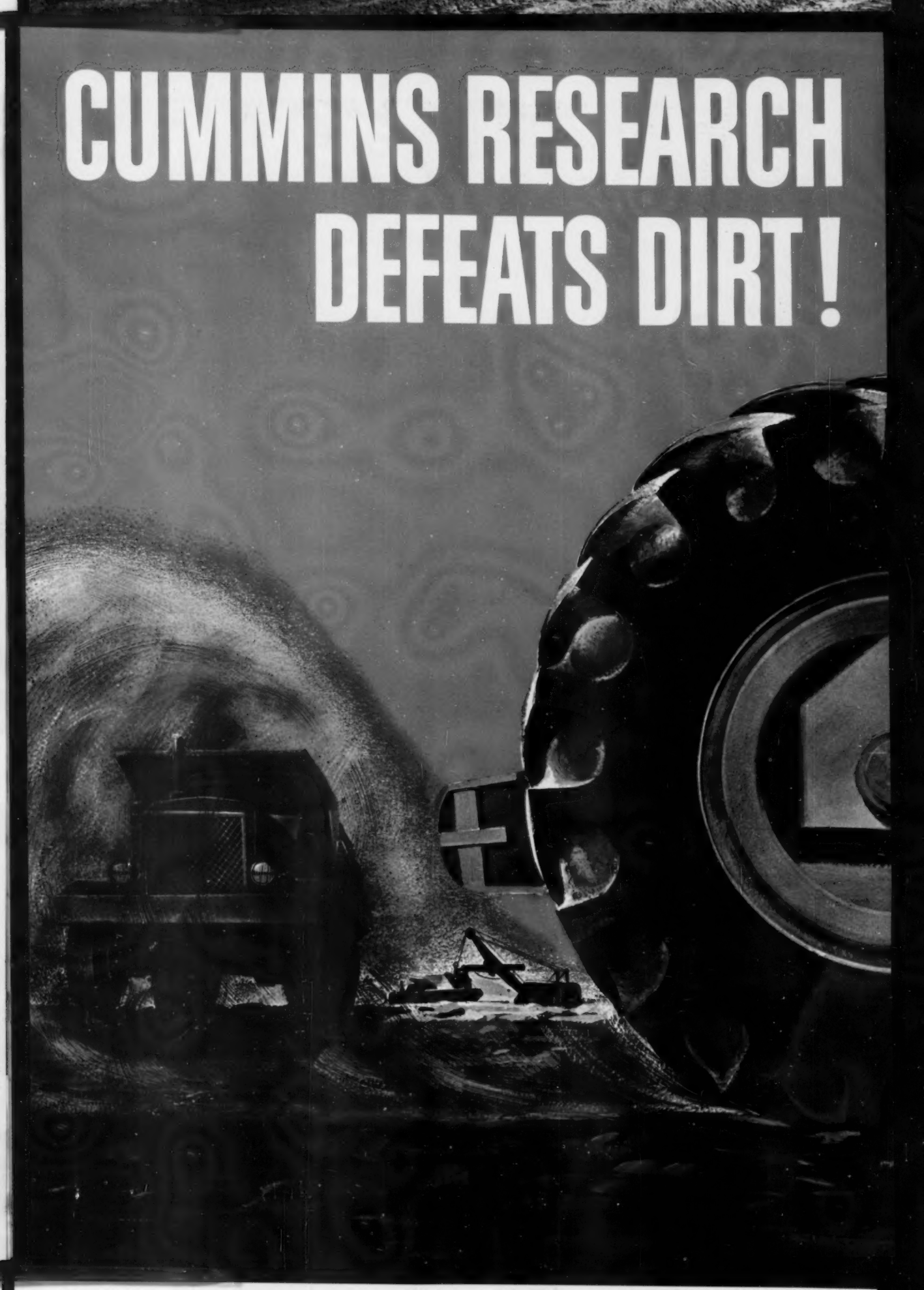
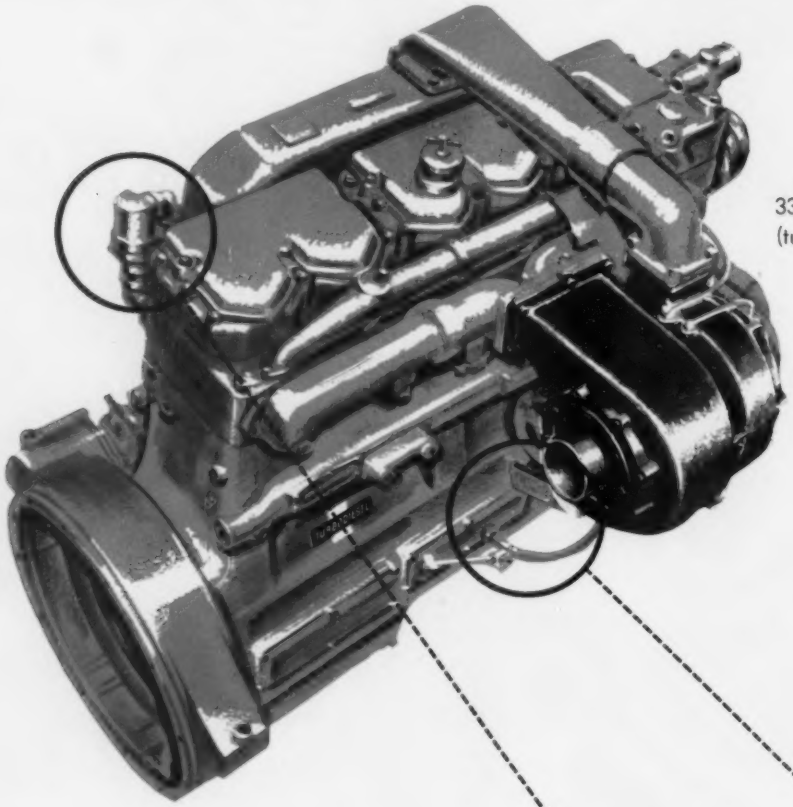

CUMMINS RESEARCH
DEFEATS DIRT!

ANNOUNCING NEW CUMMINS



335 h. p. *TURBODIESEL*® Engine (turbocharger side)

2. New Airtight Dipstick Cap

"Bottle-stopper" twist-on cap forces rubber washer to expand . . . making this opening completely airtight.

1. New Crankcase Pressurizing

Cummins-developed valve keeps crankcase pressurized to prevent dirt-filled air from entering engine. Standard on supercharged and turbocharged engines.

Cummins Oil System . . .
defeats dirt!

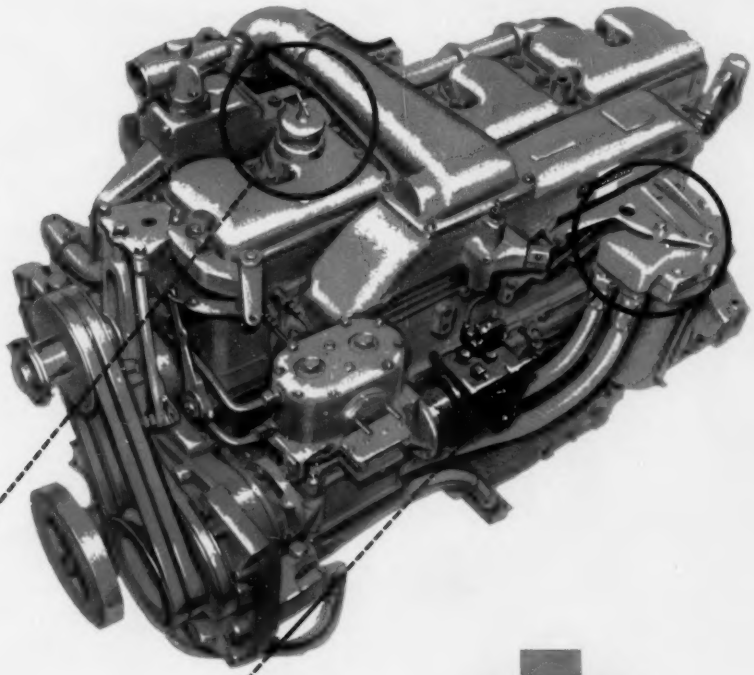
Cummins developed Crankcase Pressurizing (1) builds a predetermined amount of pressure *inside the engine*. This *low* pressure keeps dirt from entering at loose seals, worn gaskets and loose connections. New airtight dipstick and oil filler caps (2 and 3) give positive seals against dirt and abrasives. Cummins specially designed oil filter (4) gives complete, continuous oil filtration and is more efficient in capturing and holding engine-damaging impurities.

Cummins Air-Induction System . . .
defeats dirt!

A secondary way dirt enters an engine is through the air intake system. The following Cummins *firsts* (see right), coupled with the oil bath air filter, give maximum protection against dirt: (A) specially developed "hump" hose; (B) airplane-type clamps; (C) 90° molded rubber hose; (D) stainless steel welded tubing; (E) newly designed dry-type air filter. Cummins Air-Induction System provides the most modern and efficient protection available against the effects of dirt.

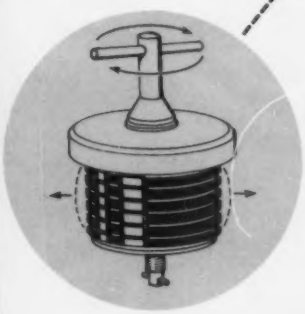
DIRTPROOFING SYSTEM

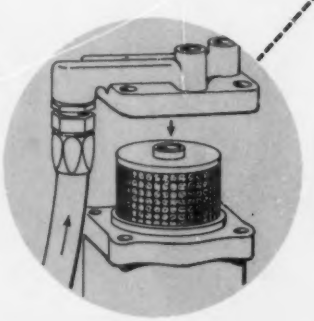
335 h. p. *TURBODIESEL*® Engine
(fuel pump side)



3. New Airtight Oil Filler Cap

"Bottle-stopper" twist-on cap provides seal at oil port against dirt and grime.



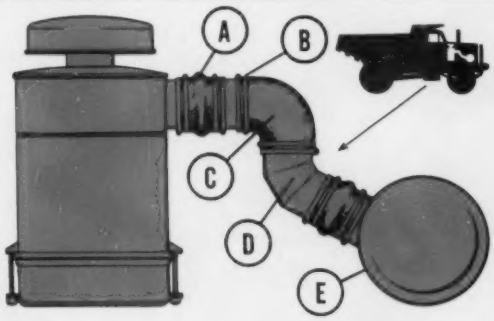


4. New Oil Filter

Cummins improved oil filter: (1) allows freer passage of lubricating oil, and (2) captures and holds more dirt.

CUMMINS

MORE PROFIT



Cummins Fuel System . . .
defeats dirt!

Dirt sometimes makes its way into diesel fuels, subjecting the moving parts in the fuel system to excessive wear. Here, too, Cummins has developed superior protection for construction diesels. The PT system's fuel filter eliminates harmful contaminants . . . keeps dirt from entering the fuel system . . . passes through dirt-free fuel. Cummins new dirtproofing system is just another reason why more and more contractors specify their power and *Standardize on Cummins!*

Cummins dirtproofing accessories are available in kit form right now! Your Cummins Distributor can convert models in the field with minimum delay. He can also arrange for you to see the new 28-minute film, "Operation Hourglass," showing how Cummins research has overcome the devastating effects of dirt on diesels. Defeating dirt is another great Cummins achievement. It's just one more reason why, for the last 25 years, Cummins has led in the development of high-speed, lightweight diesel power for automotive, industrial, construction and marine users.

Cummins Dirt Protection features are available on heavy-duty construction equipment made by:

TRUCKS
Autocar
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Cook
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PAVERS
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Worthington

SHOVELS, DRAGLINES, CRANES, HOISTS
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Clyde
Dominion
Gradall
Industrial Brownhoist
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Ohio Locomotive
P&H
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M-R-S
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LOCOMOTIVES
Baldwin-Lima-Hamilton
Canadian Locomotive
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Plymouth
Vulcan

COMPACTORS
Buffalo-Springfield

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Scoopmobile

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Eimco
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M-R-S
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CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"

Liquid AEROFLOAT® Promoters-- $elective and $aving

Are you missing a chance to cut costs and improve recovery at your flotation operation by not using a liquid AEROFLOAT Promoter? Here is what one modern lead-zinc operation recently did by adopting the use of AEROFLOAT 31 Promoter:

(1) Eliminated use of lime and labor required to prepare lime slurry. (AEROFLOAT Promoters do not generally float pyrite in neutral or alkaline circuits).

(2) Cut frother consumption in half.

(3) In the Pb circuit cut promoter consumption from 0.14 lb/ton xanthate to 0.07 lb/ton AEROFLOAT 31, and in Zn circuit cut back to 0.017 lb/ton AEROFLOAT 31 from 0.04 lb/ton xanthate.

(4) Boosted Pb recovery from 96% to 98% and Zn recovery from 78% to 86%.

(5) Saved $50 per day in reagent costs and added several hundred dollars daily in recovered metal values.

There are five liquid AEROFLOAT Promoters available, all based on the dithiophosphoric acid structure,

where R is a phenolic ring (cresol, xylenol).

AEROFLOAT 25 Promoter is the basic liquid AEROFLOAT Promoter and has limited frothing power. AEROFLOAT 15 is a slightly weaker promoter with more frothing power. AEROFLOAT 31 and 33 Promoters are fortified with strong promoters of limited water solubility. AEROFLOAT 242 is an ammonia-neutralized, water-soluble form of AEROFLOAT 31 Promoter.

If you need a selective promoter which can give you lower costs with improved recovery, why not try one of our liquid AEROFLOAT Promoters? A post card will bring you samples for testing.

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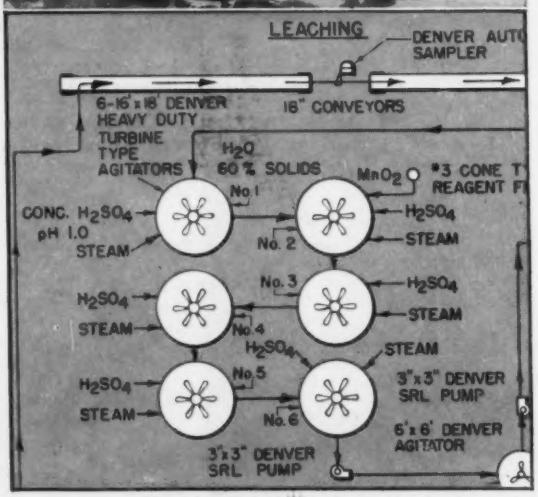
DENVER AGITATORS
at KERR-McGEE'S Shiprock Concentrator

SHOW ONLY SLIGHT WEAR AFTER 10 MONTHS' OPERATION

Kerr-McGee's Shiprock Uranium Concentrator has six 16'x18' DENVER Heavy Duty Turbine Type AGITATORS installed in the raw leach section . . . processing coarse uranium ore . . . and, after ten months, they show only slight wear!

What's more . . . these units are designed for removal and replacement of a complete propeller assembly to minimize shut-down time. Propellers and shafts are rubber covered and are provided with a threaded connection and seal for simplicity in removal and replacement of propellors. Outstanding service such as this can be applied to your process.

JAMES E. QUINN, DECO Sales Engineer and specialist in uranium extraction, practice and equipment describes in detail the Kerr-McGee Shiprock Uranium Concentrator. Information regarding the details of this operation appear as Deco Engineering Notebook Bulletin Number M4-B90. A copy will be sent you on request.



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Mining World

THE IMPORTANT MINING MAGAZINE EVERYWHERE

April 1957

INTERNATIONAL PANORAMA

WHITE PINE, MICHIGAN—Copper Range Company is expanding plant facilities to produce between 45,000 and 50,000 annual tons of copper. 1956 output was 37,759 tons.

SCHENECTADY, NEW YORK—General Electric Company scientists have developed a new compound—borazon—that is harder than a diamond. It is made of boron and nitrogen and can withstand temperatures higher than 3,500° F.

SOREL, QUEBEC—Quebec Iron and Titanium Corporation is installing three new electric furnaces here to increase production of titanium dioxide slag from titaniferous magnetite. Plant capacity will be raised 60 percent.

BINDURA, FEDERATION OF RHODESIA AND NYASALAND—The Rhodesian Vanadium Corporation has taken an option on a high grade nickel discovery in serpentine.

LANDER, WYOMING—Utah Construction Company will strip up to 2,000,000 tons of overburden from two uranium ore bodies of Lucky Mc Uranium Corporation as first phase of open-pit mining.

ST. LOUIS, MISSOURI—A new company—Mallinckrodt Metals Company—has been formed by Mallinckrodt Chemical Works to develop new uses for columbium, tantalum, and rare earths extracted from Idaho euxenite placer concentrate.

DOUGLAS, ISLE OF MAN—Two English companies are prospecting for lead and zinc. Last lead production on the island was in 1919; at one time 19 mines were in production.

HOLLANDIA, NEW GUINEA—Nickel and cobalt deposits have been discovered on Waigeo Island northwest of here. Early reports indicate substantial tonnages.

KITWE, FEDERATION OF RHODESIA AND NYASALAND—Sir Ronald Prain, chairman of Rhodesian Selection Trust, has announced that it cost about 19.00 cents per pound to produce Copperbelt electrolytic copper in 1956. United States costs averaged 18.25 cents, he said also.

GARFIELD, UTAH—Calera Mining Company, largest Western Hemisphere cobalt producer in 1956, had a record output of 2,435,976 pounds.

ISHPEMING, MICHIGAN—Cleveland-Cliffs Iron Company is seeking preferred stockholders' approval for guaranteeing $25,000,000 to partnership companies. This money could be used to triple Humboldt Mining Company's flotation plant capacity to 600,000 annual tons of concentrate and to build an agglomeration plant. Also to double to 1,200,000 annual ton capacity of Marquette Iron Mining Company's Republic plant. Expansion will be within the next few years.

TORONTO, CANADA—American Smelting and Refining Company has formed a new subsidiary—Asarco Nickel Company, Ltd.—to explore and develop nickel-copper deposits in the northern part of Ungava, Quebec. Five Canadian gold companies, headed by Little Long Lac Gold Mines, Ltd., will share in the development.

ANTIKOKAN, ONTARIO—Canadian Charleson, Ltd. is building a new Remer jig mill to treat 375 tons per hour of glacial moraine containing 10 to 13 percent iron. Concentrate will be about 40 tons per hour of 57 percent iron.

COPETON, NEW SOUTH WALES, AUSTRALIA—Geological prospecting is to be undertaken by Dr. John Williamson, head of Williamson Diamonds Ltd., Tankanyika, Africa, for industrial diamonds. Small production of industrial diamonds has been made in area for years.

CLIMAX, COLORADO—Climax Molybdenum Company is making plans to develop the 600-foot level of its mine. This is 300 feet below the Storke Level, the mine's lowest, from which 12,000 tons is mined daily.

American Zinc Purchases Grandview Lead-Zinc Mine

American Zinc, Lead and Smelting Company has purchased the Grandview zinc-lead mine near Metaline Falls in northern Pend Oreille County, Washington, for more than $400,000. The purchaser has been operating the property since 1936, first under a leasing royalty arrangement and, since 1950, on a profit-sharing basis.

Sale terms included $250,000 for Grandview's interest in machinery, equipment, buildings, and other personal property, payable $150,000 cash and $10,000 quarterly; $146,925 for Grandview's interest in estimated remaining ore reserves, payable at a royalty rate with a $25,000 annual minimum guarantee; $20,000 for remaining land and mineral rights; and, finally, royalties on ores which may be extracted above known reserves.

The seller, Grandview Mines, Inc., has withdrawn a $416,000 suit charging the operating firm with a breach of contract.

Grandview mines retains its other property holdings in Pend Oreille and Stevens counties. A section of state-owned land just north of the Spokane Indian Reservation has been leased to Mine Consultants, Inc., Spokane, for $5,000 annually. The lessee has found promising geochemical anomalies down-slope from an argillite-granite contact which yielded negative results in bulldozer and scintillator prospecting by Grandview Mines. The lessee has organized Blue Mountain Mining Company to test-drill the anomalous areas.

Supreme Court Delays Gold Case Hearing

Late in February the Clerk of the United States Supreme Court sent the following message to all parties participating in the case before the Court in regard to the WPB World War II Gold Mine Closing Order.

"The entitled case will not be reached until next term, and, accordingly, petitioner's (appellant's) briefs will not be due until August 26th, or thirty days after receipt of the printed record, whichever is later."

Informed Washington attorneys now believe that the decision in the gold cases cannot be handed down until about the first of the year, even if the Department of Justice attorneys do not ask for more time. It is considered likely that these attorneys will do so to delay the case as they have done in the past.

The gold mining industry has won its right from the United States Court of Claims to request damages for World War II forced closings. The Department of Justice then carried the case to the Supreme Court.

In May—How Bald Mountain Makes $5.35 Per Ton Gold Ore Pay

TUNGSTEN ORE is extracted at Number 2 mine using shrinkage stoping with drawpoint loading centers spaced at approximately 20-foot centers. Mucking and loading is done with Eimco 12B Rockershovels as pictured above.

Strawberry Tungsten Battles Snow, Purchases and Geology

- *Snow forces annual retreat*
- *WO_3 purchases uncertain*
- *Development complicated by unusual geology*

Mining at New Idria Mining & Chemical Company's Strawberry tungsten unit, 100 miles northeast of Fresno, California, is similar in many respects to conditions encountered in Alaska. Everything is figured by the season, and it is a short one between heavy snows at Strawberry. The mine is located at a 7,500-foot elevation in the high Sierras just a few miles away from the southern border of Yosemite National Park. The average mill run during any one year is six months or less. Despite this factor and the uncertainty facing domestic tungsten producers, New Idria is engaging in an extensive development program to add new reserves and will soon enlarge the present 120-ton-capacity mill to 200 tons per day.

The relatively remote location of the operation creates a supply problem. The mine is reached by traveling over 65 miles of paved highway between Fresno and Bass Lake, a resort area in the foothills. From Bass Lake, the 35-mile-long dirt road leading to the mine covers typical mountain terrain with steep grades and several narrow, one-track sections existing. Fresno is the nearest source of supply, and daily operations are greatly facilitated by the use of short wave radio with which calls can be placed through Pacific Telephone & Telegraph's mobile telephone operator in Fresno. The mine is in contact with the Fresno office at least once each day, and requests for supplies and parts are greatly speeded.

Unusual Geology

The property has been in intermittent operation since 1943, but in 1955 was acquired by New Idria, an important United States mercury producer, as part of a diversification program. Several small tungsten deposits are found at Strawberry, within tactite zones confined to sedimentary remnants overlying the Sierra batholith. The sedimentary series have undergone considerable erosion, and have been completely removed in many areas. The sediments are very nearly vertical in the vicinity of the mine; and metamorphism is quite evident. Many dikes cut the metamorphosed sediments, and, to all appearances, seem to have exerted considerable influence in the formation of the ore deposits. Contrary to the usual occurrence along igneous contacts, tactite zones normally follow the general trend of favorable lime beds which are crossed by aplite to granodiorite dikes at right angles to the strike of the limestone members. Where the tactite zone is cut by a dike, scheelite of ore-grade mineralization is generally highest. The dips of the various

tungsten deposits vary from 75° to 80° in a general westerly direction. The strike of individual deposits is variable, but in general is north or northeast.

New Development

Early work was confined to outcroppings worked from the surface and shallow, open-cut development at the northern end of the holdings. All ore is now extracted from underground workings which are opened by adits. Four ore shoots have been developed with three of them located north and east of the camp. The fourth deposit which is being worked is located 6,500 feet southeast of the northern workings. The various mines are designated by numbers with Numbers 1, 2, and 5 located at the northern end and Number 4 mine at the southern end. Only at Number 2 mine is a fairly typical, contact tungsten deposit noted. Adit development for these mines provided only 50 to 100 feet of backs between the sill and the surface, so preparations were underway last summer to extend development work to deeper horizons. At Number 1 mine, a shaft will be reopened and extended below its present level. At the southern end of the holdings, deeper development is taking the form of a long adit which will provide another 94 feet of back under the present workings of the Number 4 mine.

Daily production from these mines totals about 125 tons of ore which is treated in the mill located near the camp. Generally, ore widths approximate 6 to 12 feet. The grade is high (compared to other United States tungsten producers) with mill-run ore commonly running over 1.0 percent in the past. During 1956 the average grade treated was somewhat lower than this figure because development work was being pushed and a large share of the ore was extracted from pillar remnants which were reclaimed in and around old workings.

Gravity-Flotation Mill

The original mill was built by Southwestern Engineering Company and had a rated capacity of 50 tons. However, the first buildings have since been crushed by winter snows and the mill subsequently has been rebuilt twice and enlarged to its present 125-ton capacity. The concentrator is located near the northern end of the workings near the Number 1, 2, and 5 mines. Plans are now underway to enlarge the capacity to 200 tons per day and to install a new crushing plant. This will eliminate a 200-foot hand tram with 30-cubic-foot cars which is now necessary between the receiving bins and the crusher feed-hopper. At the mill a sand-slime separation is made with sands reporting to tables and the slimes to a flotation section. The gravity concentrate is roasted and fed through a Dings high intensity magnetic separator to remove sulfur and all iron bearing minerals. Actually, 1956 was the first year that sulphides began to show up in the feed in contaminating quantities. The gravity concentrate assaying 60 to 70 percent WO_3 was shipped to Fresno and ultimately sold to the government under the extended tungsten purchase program. The flotation concentrate which averages between 25 to 30 percent WO_3 was sold to Union Carbide Nuclear Company and shipped to its Bishop, California synthetic scheelite plant.

DEVELOPMENT ADIT below Number 4 mine workings is driven using Joy twin-boom Jumbo with Ingersoll Rand drifters.

Supplies are sent in every other day from Fresno during the mining season by truck. The driver remains overnight at the mine then takes out a 5-ton load of sacked-concentrate on a Ford truck the following day. This provides a payload in both directions from the central Fresno headquarters of the mine.

The buildings in the camp must be provided with steep roofs, pitching at least 45° from horizontal to withstand heavy snow loads. Where a building is constructed on a hillside, the ridge line of the roof should be oriented perpendicular to the slope; otherwise sliding snows from the roof would push the building off its foundation if one of the gables sloped into the hillside.

Snowmobile Essential

Everything considered, the Strawberry tungsten unit has a great many adverse factors with which to contend. A major project is involved each season in just moving in and squaring away for resumption of operations in the springtime. Then again in the fall everything must be secured for winter. A Frandee snowmobile and a war-surplus Army Weasle are indispensable to the company's operations. Before shutting the operation down for the winter, staple and non-perishable supplies are stocked. All fuel tanks are filled with oil. Heavy equipment, such as tractor-loaders, portable compressors, etc., is moved into the repair garage which is constructed of massive timbers. Tailing pipe, which in several sections is mounted on a light trestle, must be dismantled because the trestle is battered down every year. During the height of the winter one or two inspection trips are made to check on conditions at the idle mine. The last 35 miles, during these trips, must be

SHOWN AT LEFT is B. E. Charles, mill superintendent. At the right is M. C. Richardson, general manager of New Idria Mining & Chemical Company's Strawberry operation. Short-wave radio used by Mr. Richardson above is the only contact with Fresno.

traversed either in the snowmobile or in the weasle.

In the springtime, a great deal of dead work must be done to place the camp in condition for starting the season's operations. A small crew comes in, via the snowmobile, three to four weeks early. They immediately begin connecting water pipes, reworking the roads, and removing fallen trees where they might interfere with operations. Drainage ditches must be reopened and, more often than not, repair work is required for the several buildings. In 1956 for example, the first vanguard arrived on April 23rd and began making preparations for the season's work. The mill was started May 13th; the last snow fell on May 31. Conditions for the first month or so are far from ideal.

Mining

At Number 4 mine most of the ore originated from pillars during the 1956 season, and was hand-trammed to the surface through an adit in 30-cubic-foot cars. Underground workings were continued to the surface, and holed the bottom of a pit which had been opened a few years ago on the outcrop. The Number 2 mine is the only deposit developed on the Strawberry holdings to date where the ore-bearing tactite zone actually paralleled the true granodiorite contact. Ore was broken by drilling side-swipe rounds with airleg machines; the broken ore was loaded with Eimco 12B mucking machines. The end dump cars were unloaded into a small, 50-ton bin constructed of timbers near the portal. This bin is located about 1½-miles from the mill. A 14-ton-capacity Mack truck is used to transport the ore to the mill, and occasionally to spread fill on roadways. Furnishing air power for the operation at the Number 4 mine is a Joy, double-acting, compressor rated at 550 cubic-feet-per-minute; the compressor is driven by a Caterpillar D13,000 Diesel engine.

The lower adit being driven under the Number 4 workings will require an opening totalling 800 feet in length before ore-bearing formations are expected to be encountered. The equipment being used on this development job includes a Joy, twin-boomed jumbo which mounts two Ingersoll Rand DB 30, automatic, power-fed drifters. Timken, tungsten carbide bits and 1⅛-inch round steel are used with the drills to put in burn-cut rounds with up to 60 holes required to break the ground satisfactorily. Blasting agents used are Hercules EP 160 powder in 1- by 8-inch cartridges with Thermite caps and spitter cord. The adit is paralleling the general plane of the bedding, and the average advance per round is 4 feet. An Eimco 12B mucking machine is used to clean up the round, and the ore is loaded in 30-cubic-foot Miners Foundry and Manufacturing Co. cars. The cars are trammed to the portal by a Greenburg locomotive powered by Gould batteries. Air for the drilling and mucking operations is furnished by a Gardner Denver compressor rated at 500 cubic-feet-per-minute. The adit is tracked with 25-pound rail on an 18-inch gauge.

Shrinkage Stopes

The group of mines in the northern end of the holdings are all developed by adits. Number 5 mine is presently inactive. The general method of mining employed is shrinkage stoping with drawpoint loading using mucking machines. Drawpoints are spaced on 20-foot centers and empty directly into the development drift. Control lagging is thrown across the face of the drawpoint to stop the muck-flow when desired, thereby preventing drift tie-up. Development drifting is carried right in the narrow tactite zone. The drawpoint is driven using a drift round at right angles to the development heading; then raising straight up for one round before inclining the drawpoint back over the top of the drift heading. The sill of the stope is started 14 feet over the back of the development drift.

Ore from the Number 2 mine is hand trammed to the portal where it is taken out over a trestle and dumped on the ground to be picked up later with an Allis Chalmers HD-5 tractor-loader for transfer to bins serving the mill.

Raising, which was in progress last summer, will connect workings of the Number 1 and 2 mines and provide an opening for deeper development of the present Number 2 workings.

Milling

The scheelite ore is very brittle and breaks quite easily; however it is very abrasive. The present crushing plant operates 12 to 16 hours per day; the installation consists of a Pacific 10- by 20-inch jaw crusher and a Symons 22-inch cone crusher which reduce the ore to a relatively coarse 1-inch size for ball milling. One of the biggest handicaps in the milling operation is the lack of adequate bin capacity at the crusher head. A hand tram is now necessary between the mill bins and the primary crusher. A new installation is being designed and work will start on a revised crushing plant which will eliminate this problem.

Coarse Grinding

For grinding an Eimco 5- by 4-foot ball mill is used and this unit is in closed circuit with a pair of vibrating screens. The objective sought during grinding is a relatively coarse particle size for treatment in the gravity section of the mill. The ball mill is operated with a light load of balls (2-tons) and quite empty and noisy. This increases liner and ball consumption rates but reduces excessive production of slimed scheelite which must be treated by flotation with a lower recovery and grade of concentrate. Each day an 85-pound charge of 3-inch forged steel balls, made by American Forge Company, is added to the ball mill. The first set of shell liners wore out and was replaced after 17,765 tons of ore had been treated. The second set of shell liners treated 17,005 tons of ore. The end liners and grate have been replaced only once after grinding 34,770 tons of ore. The new end liners which were added were considerably thicker and heavier.

To obtain a relatively coarse grind the ball mill is fed with a dilute pulp and is never crowded. Once each month the mill is unloaded and the small balls are sorted out; a ball 1-inch in diameter or smaller is removed at this time.

Screening is the means used to scalp out oversize particles for return to the ball mill. For this purpose a Link Belt 2- by 5-foot vibrating screen and an Overstrom 4- by 5-foot vibrating screen are arranged in series. The latter screen is equipped with a stainless steel deck with 18-mesh openings. The Link Belt screen contains 10-mesh openings. The oversize from each screen is recycled to the ball mill; the undersize from the 10-mesh Link Belt screen reports to the Overstrom screen and the undersize from the Overstrom screen feeds to a five-compartment Concenco, hydraulic classifier. The carefully sized spigot products of the five compart-

STAGE CLEANING of the flotation concentrate produced in the combination gravity-flotation mill is done in a Denver 6-cell machine shown at the left. Feeders on the flotation cells are Clarkson. Classified ball mill discharge containing coarse fraction is concentrated by tables such as the Deister Concentrator Co. diagonal-deck unit at right.

ments are directed to a set of five rougher tables which produce a rougher concentrate, a middling, and a finished tailing. The overflow from the hydraulic classifier goes to a flotation circuit in the mill.

Flotation

Approximately 45 percent of the original mill feed reports to the gravity circuit which includes a set of rougher tables (four Wilfley and one Deister super-duty diagonal deck) and a cleaner table. The remaining 55 percent of the feed is processed by flotation in a five-cell bank of Galigher roughers and a six-cell Denver Equipment Company machine which provides four-stage cleaning. Sulphides included in the gravity concentrate are eliminated by roasting and magnetic separation.

The pH of the fresh water supply for the mill is about 9.0 which helps produce a well dispersed pulp, but creates a thickening problem. The overflow from the hydraulic classifier must be thickened for flotation. The introduction of Aerofloc 3,000 to the Dorr thickener by a Clarkson reagent feeder not only greatly increased settling rates, but also reduced the amount of slimes in the thickener overflow. These slimes usually contained a small percentage of scheelite.

Flotation is carried out at the normal temperature of the water supply which generally ranges at 14.5 to 15° C. Early in the season or late in the year, cold weather may force the pulp temperature down to about 6° C. Two conditioners are used ahead of the flotation roughers and powdered soda ash, sodium silicate, and Palcotan are added at the first conditioner. Total retention time is about 20 minutes in the first conditioner. Soda ash is added to produce a pH of 10.0 to 10.2; sodium silicate is a dispersant and silica depressant; and the Palcotan depresses carbonates. Sodium silicate provides good dispersion of pulp previously flocculated at the thickener.

Heated Collector

At the second conditioner, modifiers and collectors are added. Aerosol 18, a detergent, is a surface active agent fed at the rate of about 0.06 pounds per ton to the second conditioner. It also helps emulsify and stabilize the collector, which is a one-to-one mixture of oleic acid and Aero reagent 708, and produces a light, watery froth. The oleic acid collector is cut with less expensive reagent 708. The mixture is heated to keep the oleic acid from separating. Below 20° C., oleic acid is sluggish in action. An electric heater is installed under the fuel oil drum in which the collector is mixed. To keep the mixture from cooling in the Clarkson reagent feeder, an ordinary 60-watt light bulb, connected to a power source, is inserted in the liquid bath of the feeder. A screen placed over the opening through which the light bulb is inserted guards against the hazard of explosion. Total retention time at the second conditioner is approximately 13 minutes. Aerofroth 65 is the frother.

At the cleaner cells, sodium silicate is added to the next to last cleaner, and a mixture of 3 percent Palcotan and 2 percent Aero reagent 610 is added to the last cleaner. Reagent 610 is primarily a mica and carbonate depressant; it is particularly advantageous in pulps containing colloidal slimes due to its dispersing power.

Roasting Concentrates

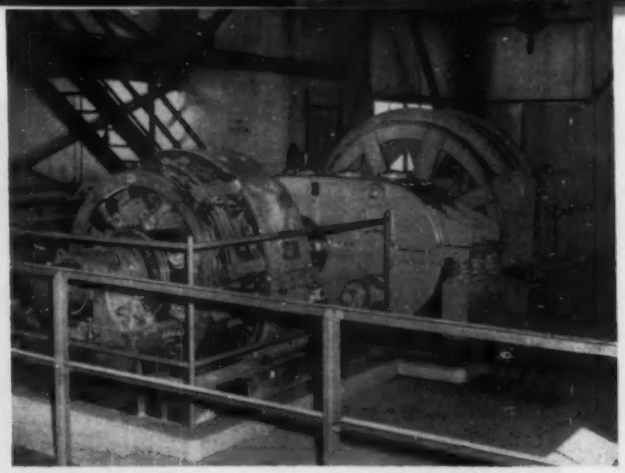
Flotation concentrates are partially dried on a Decco pan filter and sacked for shipping. Table concentrates are roasted to oxidize iron sulphides for subsequent removal by magnetic means. The roasting plant, adjacent to the mill, is operated one shift per day. The roaster is a rotary kiln, 31 inches in diameter by 16 feet long, using one burner fired by Diesel oil. The roaster calcine is then fed to a Dings high intensity magnetic separator. The concentrates are bagged for shipment.

The gravity concentrate assays 60 to 70 percent WO_3 and the flotation concentrate 25 to 30 percent WO_3. Each is shipped to Fresno via the supply truck leaving the mine every other day. The gravity concentrate enters the government stockpile and the flotation concentrate is sold to Union Carbide Nuclear for further processing.

The Strawberry operation is typical of the many small and remote mining operations peculiar to the industry. Courage and ingenuity are the basic elements required to face the risks involved in developing such properties. Under the direction of Strawberry general manager, M. C. Richardson, and B. E. Charles, mill superintendent, New Idria possesses both, plus the know-how needed to make the enterprise successful.

THE END

TWO ASEA HOISTING DRUMS are shown in this view. Note the brake drums turned directly on the hoisting sheaves. The brakes are operated pneumatically.



WESTINGHOUSE 1500-hp DC motors operate the friction-type hoists. Power from the motors is transmitted through the ASEA floating type gear boxes shown behind the motor.

Cleveland Cliffs' "C" Shaft Uses First U. S. Koepe Hoisting System

By HENRY G. GRUNDSTEDT
Manager Engineering Services

The huge T-shaped structure forming an outstanding part of the Ishpeming, Michigan skyline is the reinforced concrete headframe over the Cleveland-Cliffs Iron Company's new "C" shaft. Housing a Koepe-type hoisting system, it is the first installation of its kind on the Marquette Iron Range—indeed, the first in the United States.

The new "C" shaft, replacing the now obsolete, previously used, "A" and "B" shafts, has a hoisting capacity of 4,000 long tons per eight-hour shift, as compared to a combined capacity of 2,200 long tons during a two-shift period for the old "A" and "B" shafts. Labor duplication has been eliminated with this one centralized hoisting system; in fact, almost all labor has been eliminated from shaft operation by use of the friction-type, automatic Koepe system. A cager and skiptender are all that are necessary to operate the six-compartment shaft. Containing a cageway, two skipways, a manway, two pipe and cable compartments, and three smaller counterweight compartments, the 1,356-foot shaft was sunk by surface excavation and raising from underground. Surface excavation was accomplished by sinking a coffer dam to bedrock, while raising was carried through from existing levels. The shaft passes through one worked-out stope. The shaft was started in early 1953 and completed during 1955.

A large underground crushing and screening station adds to the efficiency of the hoisting plant. Handling an average of 3,200 long tons of iron ore per shift, the plant crushes the ore to minus-6-inches before it is hoisted to the surface. By crushing and screening the ore in this manner, plugged chutes are virtually eliminated, thus increasing the speed of the over-all hoisting operation.

Why the Koepe System?

The decision to place the "C" shaft midway and in line with the old "A" and "B" shafts which are approximately 800 feet apart was based on the fact that this centrally located shaft had to be in the best possible spot for future access to the hard and soft ore available to be mined. Midway between the two shafts seemed like the best bet; however, installation of a conventional A-type headframe and hoisthouse meant considerable excavation and the removal of several large buildings to insure the proper fleet angle. A possible solution to this problem was the consideration of a Koepe or friction-type hoisting system, involving a reinforced concrete headframe with a rectangular cross section; with the hoists mounted at the top of the structure. A subsequent trip to Sweden during the summer of 1952 by Onnie Marjama, mine superintendent, and R. G. Schaal, chief mechanical engineer, to study the Swedish friction hoisting systems, convinced all who were concerned that the Koepe system would be suitable at the Cliffs Shaft mine. Accordingly, sinking operations were started in January 1953.

ONNIE MARJAMA, mine superintendent (left), is shown discussing the operation of the Koepe hoisting system with Bob DeGabriel, project engineer of the Cliffs Shaft Mine.

Raising the Shaft

Shaft construction was carried on simultaneously from the surface and from underground. Underground operations were started from the 15th level of the mine in the back of an open stope, with a seven-by seven-foot pilot raise carried up the centerline of the shaft. Raises along the shaft centerline were carried up simultaneously from the 10th, 8th, 5th and 2nd levels and stopped within 44 feet of the bedrock-overburden contact.

Surface excavation began with an open cut, with mucking operations being carried out by power shovel and truck haulage. The cut was carried down to a depth of 15 feet, from elevation 1,425 feet to 1,410 feet. At this point a 44-foot-square, sheet-pile, coffer dam was driven downward to the sloping bedrock at elevations 1,371 and 1,365 feet. Below these

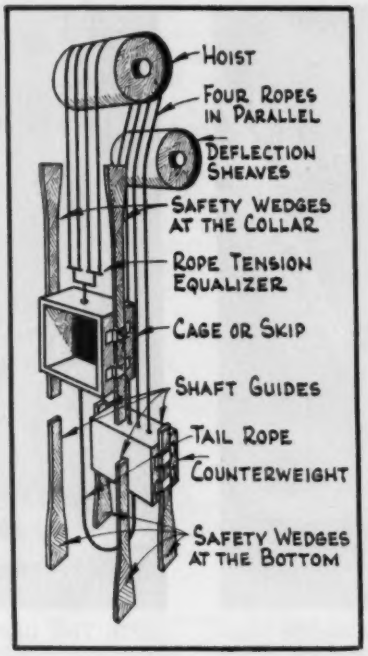
elevations, the dimensions of the excavation were decreased to 17 by 23 feet, thus forming a shoulder at this point. Exposed rock walls were concreted down to elevation 1,332 feet. Concrete poured was at least two feet thick until, at the bottom of the coffer dam, the inside shaft dimensions of 12 by 18 feet, 8 inches were reached. The shoulder which was excavated provided a base for the 12-inch, I-beam, shaft-bearing sets.

A series of drain pipes were installed in the concrete to provide a drain for the large amount of water encountered during the surface excavation. Water was pouring into the coffer dam at the rate of over 1,000-gpm, and, as a result, the entire excavation had to be carried downward by halves, one-half acting as a sump while work was being continued on the other half. A Bucyrus Erie Hydromucker with an Ingersoll Rand K4U air hoist, attached to the internal bracing of the coffer dam, was used for the excavation work. The Hydromucker dumped into a 1¾-yard tray which was lifted out of the pit by a crane.

Complete elimination of water was made possible by a ring of percussion type holes drilled through the concrete shaft collar to allow for an extensive grouting program. By this means, all water had been eliminated, and the shaft today is quite dry.

Hole Through to Raise

From the floor of the coffer dam, a nine-foot hole was drilled to hole through to the pilot raise. After blasting through to the raise, slabbing to the shaft's rock dimensions of 13 by 20 feet was carried on downward. Hanging rods were not used in the shaft; instead, shaft sets at seven-foot intervals, comprised of six-inch, 20-pound, H-beams, were hung from angle irons set in each corner of the shaft. The H-beams sets were also attached to umbrella sets which were installed at almost every set. Umbrella sets consisted of a slab of concrete, having a trapazoidal cross section, attached to drift pins placed into the shaft walls. Approximately 58 feet of the shaft went through an open stope. The old stope, previously partially filled, was cleaned out to allow for the shaft. The umbrella sets were fastened to the stope pillars on the east and west side of the shaft. An open space exists on the north and south sides of the shaft in this particular stope. Heavy, 14-gauge, corrugated, galvanized steel sheeting lines the inside of the entire shaft. Although the mine level interval is 50 feet, shaft stations are located only on levels 1, 2, 5, 8, 10, and 15. The crusher station is located on the 16th level, ore loading pocket on the 17th, and the skip pit is situated on the 18th level. The skip pit is a small station cut out at the bottom of the shaft housing a slusher, slusher ramp, and mine cars; designed to accommodate any spillage of muck from the skips.



Koepe System

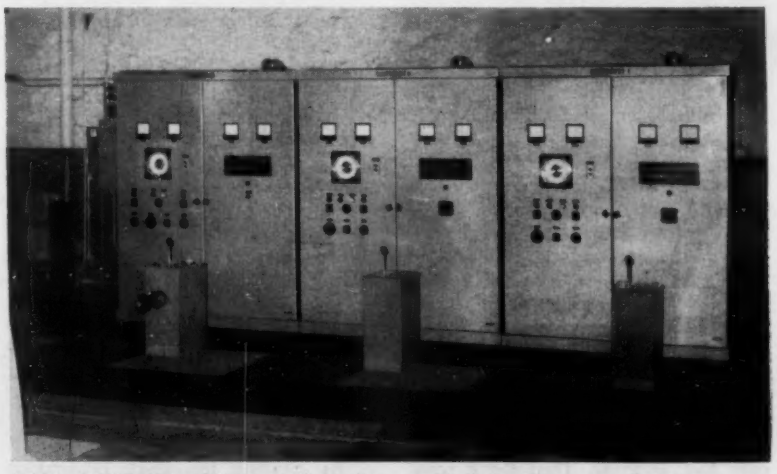
Officials at the Cliffs Shaft mine knew the size and capacity of the shaft they wanted to sink. As a result the hoisting system had to be designed to accommodate the specifications of the shaft planned. The Koepe or friction-type hoisting system was decided upon mainly because of the relatively small amount of space required for installation as compared to conventional type hoists; also, increased safety, lower peak power demand, and increased capacity due to the independent operation of single hoists with counterweights affected the decision.

Friction Drive Principle

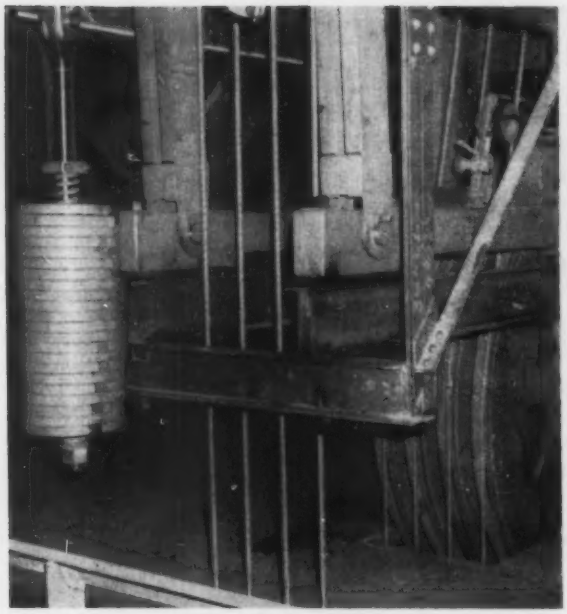
In the "C" shaft installation, four ropes are used in parallel to increase the friction factor and to insure increased safety of operation. The ropes are wrapped around a driving pulley once, so that the arc of contact between the rope and pulley covers only part of the circumference. Ropes are joined to either a cage or skip on one end, and to counterweights on the other, by means of simple balance arms similar to whiffletrees. This provides equalization of the loads on the parallel ropes. Friction between the ropes and the pulleys is sufficient to impart the required driving or braking force. One of the design requirements is that the ratio between the rope loads on each side of the pulley does not exceed a certain figure called the pulley constant, which is determined by the arc of contact between rope and pulley and the coefficient of friction.

Grooved pulleys for each rope are lined with leather. The specific pressure of the ropes in the grooves is kept below a certain maximum figure, determined by the manufacturer from past experience, in order to prolong the lining life over a period of years. The fact that the rope will slip if the ratio between rope loads exceeds the limiting value is used to give additional safety against rope failure in case of overwinding of the hoist.

Past experience and time studies have shown that greater economies are possible with the use of two independent hoists with counterweights, rather than one hoist with balanced skips or cages. Studies by Cleveland



ASEA CONTROL PANEL regulates the control of the Koepe-type hoisting system. Pushbuttons operated by the cager and a skiptender direct the hoisting operation.



THIS COUNTERWEIGHT automatically actuates the emergency braking system should the operating brakes fail. Sheave seen in background is a deflection sheave.

NOTE THE OPPOSITE LAY of the four hoisting ropes to keep them hanging parallel. High friction material is placed in the drum grooves to help prevent rope slippage.

Cliffs engineers have found it practical to use independent hoists.

The counterweight balances the cage, or skip, and half the load. Torque is the same whether a loaded skip is hoisted, or an empty one lowered.

Ropes

The Koepe or friction-type hoisting system utilizes a balancing tail rope of the same weight per unit length as the hoist ropes. A tail rope carries only its own weight, resulting in small stress compared to the rope's strength. Service life of the ropes, therefore, is much longer than that of the hoisting ropes. Guides are needed at the bottom of the shaft where the tail rope turns, and, as a result, the tail ropes are able to perform the job of balancing the hoist ropes and reducing peak power demands quite simply and effectively. The guides, wooden rub bars, prevent any rubbing on steel or intertwining of the ropes.

If, as is the case of the "C" shaft, predetermined figures are given for depth of shaft, hoisting capacity, and safety factor, four ropes can be utilized instead of one, the diameter of these parallel ropes, as well as that of the pulley becomes only half as large. This results in a considerable reduction both in weight and inertia. Also, with a given hoisting speed, the speed of the pulley with half the diameter will be twice as large as with a single rope, and the resulting torque will be only half as great. Thus the driving motor can be built for greater speed, and gear reduction decreased. All these factors, resulting in reduced weight, smaller dimensions, and reduced inertia of the hoisting equipment, make it practical to install this machinery at the top of the headframe.

With four hoisting ropes, the life of each rope is extended, as only one quarter of the load is applied to each rope. Elimination of the fleet angle also extends rope life somewhat. This, of course, is inherent with the Koepe system as both ends of the rope are in the same vertical plane.

Rope diameter is determined by capacity of the hoist, ultimate depth of the shaft, and required safety factor. Bending stresses of the hoisting ropes are taken into consideration to arrive at an economical ratio between pulley and rope diameters (D/d). This ratio is usually chosen between 80 and 100, although D/d at the "C" shaft is 105.

Another point to be considered in selecting D/d ratios is rope creep. Due to the varying degrees of rope stretch caused by unequal loading of the hoisting system, continuous rope creep occurs. To minimize wear on the friction lining of the sheave grooves, Swedish engineers have found it best to use a D/d ratio over 80, giving a rope pressure not over 275 pounds per square inch at maximum hoisting depth.

Automatic Synchronizers

As can be imagined, continuous rope creep or rope stretch causes a small shift in the spotting location of the skip or cage at various levels. It is necessary to have accurate spotting of the cage at various levels because cage chairs cannot be used due to the resulting slack in the ropes, causing slippage on the hoist drum.

Automatic synchronizers have been developed which continuously regulate the rope creep or stretch once in each complete hoisting cycle. Every time the cage or skip stops at the collar of the shaft or dumping station, the synchronizing mechanism adjusts the position of the hoist regulator. If the cage is stopped at a position where the synchronization mechanism is located, and if the regulator is exactly synchronized with the cage position, two electrical contacts in the mechanism will be open. If, due to rope creep, slippage, or stretch, synchronization has been disturbed, one or the other of the contacts is closed, depending upon whether the hoist is advanced or retarded relative to the cage. Closing of either of the contacts energizes the motor which drives the regulator in the proper direction to bring it into the correct position relative to the cage.

Concrete Headframe

The tall, T-shaped, reinforced-concrete headframe housing the friction hoisting machinery over the "C" shaft is 174 feet high, and has a rectangular-shaped cross-section. A stairway and service elevator are contained in the structure, as well as large steel hoppers which receive ore from the skips, and a heavy-duty, 4- by 12-foot

pan feeder. The feeder supplies mine ore from the crushing plant to a 30-inch belt conveyor, which conveys it to a loading house for shipping or stockpiling. Skips used are 240-cubic-foot, Lake Shore Engineering Company, bottom-dump skips.

Hoisting equipment installed at the top of the headframe, as well as the balance of the control equipment, was manufactured and prefabricated in Sweden by the ASEA company. All parts of the system are remotely operated by push-button control. Since the shaft dimensions were predetermined, the hoists were designed to fit the shaft. This necessitated the use of deflection sheaves, and the installation of the two skip hoists in a V-position, instead of in a parallel installation. The cage hoist is located above the two skip hoists. To insure that the four hoisting ropes in each shaft compartment would hang parallel, thus minimizing guide wear, ropes of opposite lay were placed beside each other.

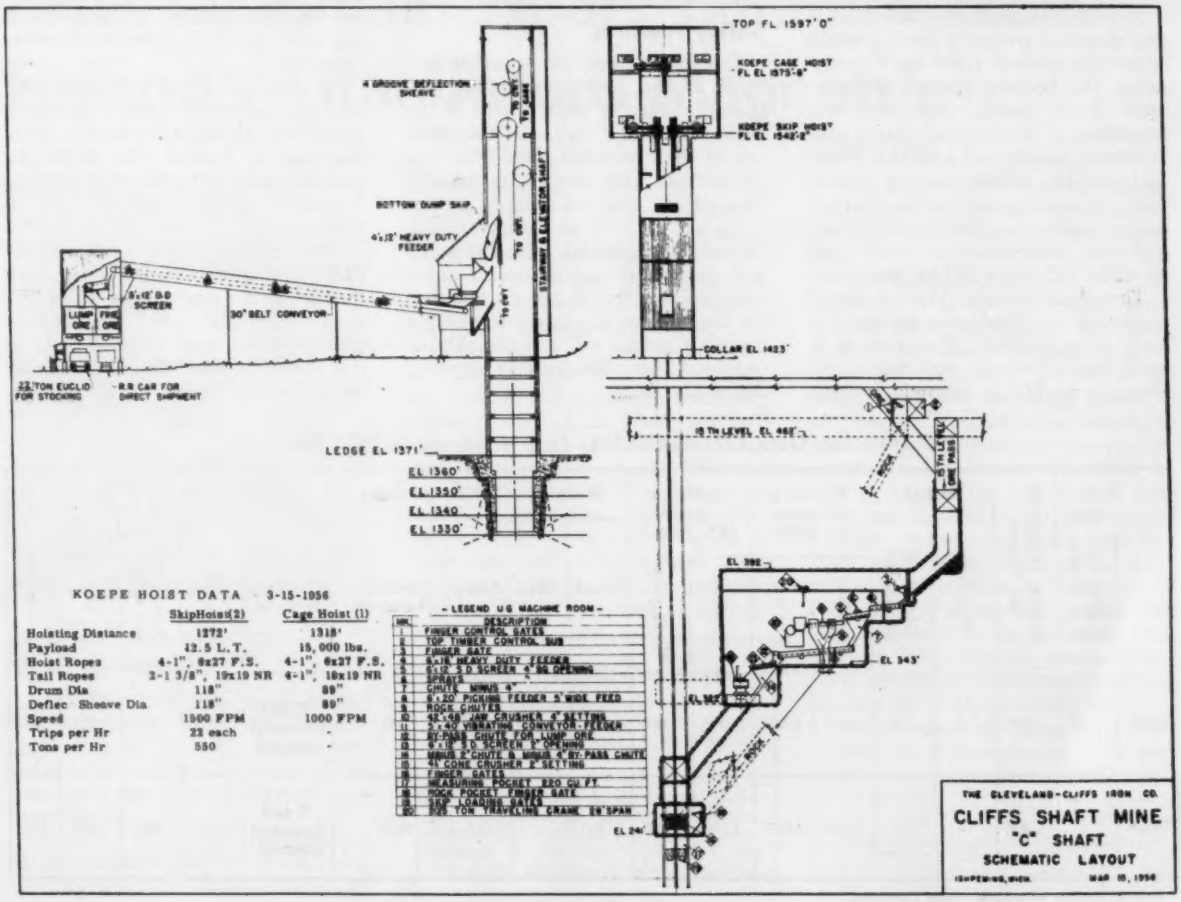
Skip hoisting drums are 118 inches in diameter, and contain Bethlehem Steel Company ropes 1-inch in diameter, giving a D/d ratio of 105. Counterweight load is 17½ tons, which balances the weight of the empty skip (10 tons) plus half the weight of the load 7½ tons). Consequently, only half the load is being raised in any direction of travel of the hoist. Rope weights do not have to be considered, as the tail rope cancels out the weight of the hoisting rope. The pulleys are driven through floating type ASEA gear boxes by Westinghouse 1500-hp, DC motors, requiring 525 volts, and operating at 600 rpm. The floating action of the gear boxes is obtained from the spring mounts they rest on which enable the gears to follow the slight deflections of the rope pulley shaft, and to allow for possible misalignment. Also, the springs smooth out load peaks which occur during starts and stops, and particularly during emergency braking. Further refinements in gear box movement are special hydraulic damping cylinders. All bearings for pulleys and gear boxes are of the roller type.

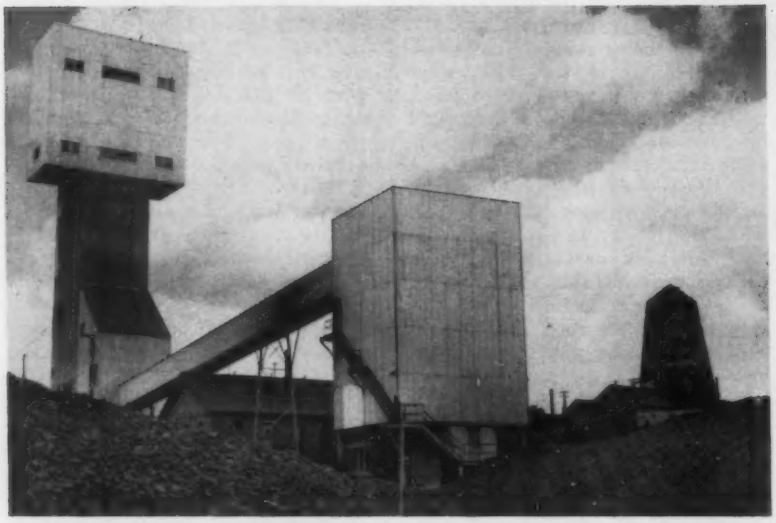
Brakes

The "C" shaft friction hoisting system has two independent braking systems. They consist of an operating brake and an emergency brake, both pneumatically operated. Emergency braking can be effected either manually or automatically.

Two brakes, connected by a linkage, bear against brake drums turned on each end of the hoisting sheaves. The rear brake posts and the front posts are movable on top and stationary on the bottom. Brakes are applied by compressed air entering two small cylinders incorporated in the braking system which press the movable brake shoe against the brake drum. When the air is exhausted from one end of the double-acting cylinders, the brake is pulled away from the drum by valve action in the air cubicle.

In the event of failure of the operating brake power system, an emergency brake is brought into action by means of a falling weight. The emergency braking system also contains a pneumatic cylinder, whose piston supports the dropping weight. When an emergency stop occurs, compressed air enters the operating brake cylinders, and, at the same time, exhausts from the emergency brake cylinders. As the charging rate of the operating brake cylinders is much higher than the exhaust rate of the emergency brake cylinder, the drop weight is prevented, therefore, from reaching its bottom position since the weight is balanced as soon as the moving brake shoe is applied to the drum. In this


TOP EL 1597'0"
KOEPE CAGE HOIST
EL EL 1575'-6"
KOEPE SKIP HOIST
FL EL 1542'-6"
4 GROOVE DEFLECTION SHEAVE
BOTTOM DUMP SKIP
4½'Ø' HEAVY DUTY FEEDER
5'x16' BD SCREEN
30" BELT CONVEYOR
LUMP ORE
FINE ORE
22 TON EUCLID FOR STOCKING
R.R. CAR FOR DIRECT SHIPMENT
COLLAR EL 1423'
LEDGE EL 1371'
EL 1360'
EL 1350'
EL 1340'
EL 1330'
EL 398'
EL 345'
EL 240'
KOEPE HOIST DATA 3-15-1956
Skip Hoist(2)
Cage Hoist (1)
Hoisting Distance 1272' 1318'
Payload 12.5 L.T. 15,000 lbs.
Hoist Ropes 4-1", 6x27 F.S. 4-1", 6x27 F.S.
Tail Ropes 2-1 3/8", 19x19 NR 4-1", 18x19 NR
Drum Dia 118" 89"
Deflec Sheave Dia 118" 89"
Speed 1500 FPM 1000 FPM
Trips per Hr 22 each -
Tons per Hr 550 -
- LEGEND U/G MACHINE ROOM -
NO. DESCRIPTION
1 FINGER CONTROL GATES
2 TOP TIMBER CONTROL SUB
3 FINGER GATE
4 6'x16' HEAVY DUTY FEEDER
5 6'x16' S.D. SCREEN 4" SQ. OPENING
6 SPRAYS
7 CHUTE - MINUS 4"
8 6'x20' PICKING FEEDER 5' WIDE FEED
9 ROCK CHUTES
10 42"-96" JAW CRUSHER 4" SETTING
11 5'x40' VIBRATING CONVEYOR-FEEDER
12 BY-PASS CHUTE FOR LUMP ORE
13 6'x16' S.D. SCREEN 1" OPENING
14 MINUS 2" CHUTE & MINUS 4" BY-PASS CHUTE
15 4½ CONE CRUSHER 2" SETTING
16 FINGER GATES
17 MEASURING POCKET 220 CU FT
18 ROCK POCKET FINGER GATE
19 SKIP LOADING GATES
20 200 TON TRAVELING CRANE 58'SPAN
THE CLEVELAND-CLIFFS IRON CO.
CLIFFS SHAFT MINE
"C" SHAFT
SCHEMATIC LAYOUT
IRONWOOD, MICH. MAR 15, 1956



THE STRUCTURE AT THE LEFT is the huge reinforced concrete headframe over the Cliffs Shaft Mine's new "C" shaft. Old building at right is formerly used "B" shaft headframe.

manner the brake is rapidly applied, and its braking effort steadily increased during the braking process without superimposing the two braking systems.

Electrical System

A metadyne regulated, Ward-Leonard electrical system is used in which separately excited 1,500-hp Westinghouse DC hoisting motors, are operated from motor generator sets consisting of three-phase, Elliot synchronous motors and 1,500-hp Westinghouse DC motors used as generators. The motor-generator for the cage hoist consists of a 750-hp AC, Westinghouse, induction-type motor, and an Allis-Chalmers 1,200 kw generator.

The direct-current Ward-Leonard control is an ideal arrangement for pushbutton control. The system is easily and effectively controlled, and responds readily to dynamic braking without loss of the regenerated power since the power is returned to the line.

The entire hoisting operation is remotely controlled by push-buttons, either by the cager at a level, or by the skip tender at the loading pocket.

Safety Features

One of the most obvious safety features of the Koepe system as employed at the "C" shaft is that of the multiple hoisting ropes. In the event one of the four ropes should fail, the other three have more than enough strength to bring the hoist to a stop.

Should the hoist tend to overwind, the mechanical-electrical limit switches will actuate the braking system. If for some reasons the brakes do not stop the conveyance, the safety wedges on the shaft guides will halt the skip or cage and cause the hoisting ropes to slip on the drum.

Aside from these normal safety devices, numerous other devices have been installed to check the correct operation of the hoist. Protection has been incorporated into the hoisting system to protect against faulty brake operation during each start and stop; excessive wear of brake lining is automatically checked, as well as any interruption in the drive of the protective and controlling devices.

Underground Crushing Plant

During the earlier operation of the "A" and "B" shafts, crushing and sizing was done on the surface. This method proved to be a constant source of annoyance and delay. Chutes had a tendency to hang up with the passage of the unsized or oversize rock, and miners were delayed in their work of trying to produce a relatively even sized product. As a result, part of the planning for the new "C" shaft included an underground crushing plant to produce crushed, sized ore from the mine.

Mine ore, at approximately minus-two-feet enters the plant. The ore is then crushed to minus-6-inches, before it is dumped into the 220-cubic-foot loading pocket for skip loading. Finger gates control the flow of ore into the loading pockets, allowing only the exact amount of ore to enter.

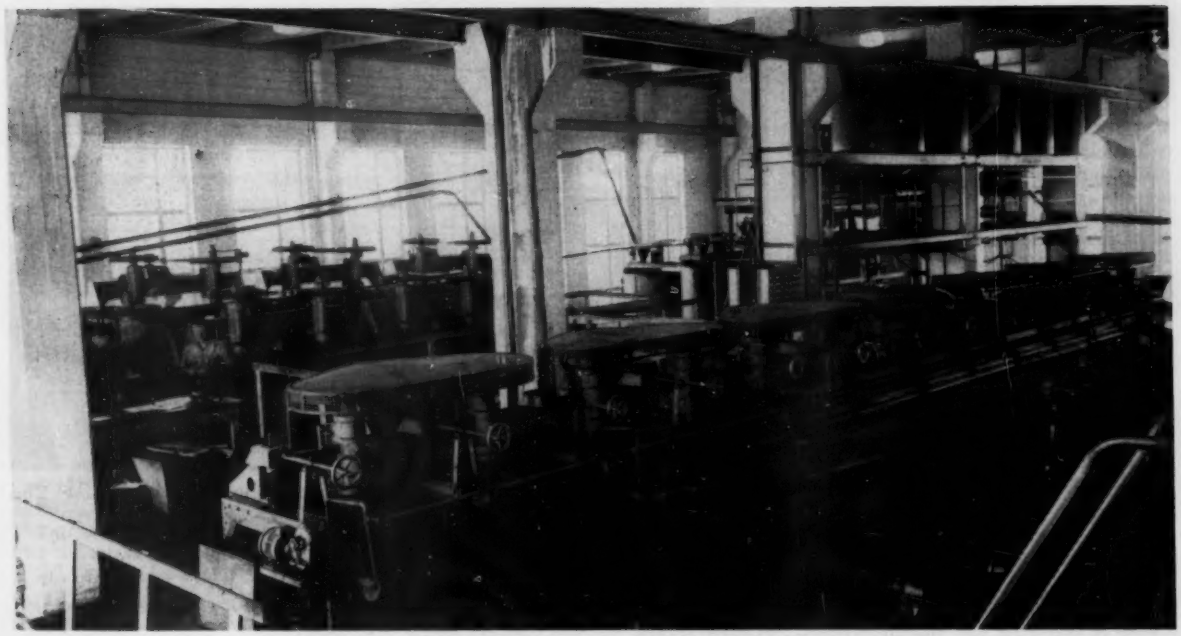
As soon as the skip is in exact position, an electrical contact is made, permitting the skip to be loaded. After the skip is loaded, the skiptender presses a release button, and the skip is hoisted, dumped, and returned automatically.

The evident success Cleveland-Cliffs Iron Company is having with the Koepe hoisting system at its "C" shaft, will undoubtedly contribute greatly to the more extensive use of this system by other mining companies in the United States. THE END

Hoisting Data Cleveland-Cliffs Iron Company's "C" Shaft

	Number of Hoists	Pulley Diameter in Inches	Ropes		Winding Distance in Feet		Hoisting Speed (Ft./Min.)		Weights (1,000 pounds)				Hoist Motor Data*				
			Number	Diameter in Inches	Present	Future	Present	Maximum	Load	Skip	Cage	Counterbalance	Electric System	Horsepower	Revolutions per minute	Volts	Current
Skip	2	118	4	1-0	1,272	4,000	1,500	2,000	30	20		35	Ward Leonard control	1,500	600	525	D.C.
Cage	1	89	4	1-0	1,316	4,000	1,100	2,000	15		13	20.5	Ward Leonard control	1,500	600	525	D.C.

* Remote control manually (push button).



ILMENITE FLOTATION section of mill. Deslimed feed is carefully conditioned in a neutral circuit. Rougher flotation with a tall oil collector takes place in an acid circuit with close pH control. Rougher concentrate is refloated.

How Otanmaki Floats Ilmenite From Finland's Titaniferous-Magnetite

By URMAS RUNOLINNA
Mill Superintendent

The Otanmaki Company owned and operated by the Finnish government is now Europe's largest producer of vanadium as well as an important producer of ilmenite and magnetite.

Since the mill went into operation in 1954 notable progress in ore dressing methods have been achieved by the staff. Tonnage throughout exceeds designed capacity, a high grade magnetite concentrate is produced from which in turn vanadium is recovered, and a very carefully controlled and operated flotation circuit makes a high grade ilmenite concentrate.

Concentration of magnetite-ilmenite ore similar to Otanmäki ore has been reported only in two other places in the world. These are A/S Titania[1] in Norway and the MacIntyre Development of the National Lead Company[2] at Tahawus, New York. The former was started in 1936, the latter in 1941. A comparison of these ores with the Otanmäki ore is given in Table No. I. The Otanmäki and MacIntyre ores contain approximately similar percentages of magnetite and ilmenite, while the magnetite content of the Titania ore is radically less.

For Otanmäki ore, good practical liberation of magnetite and ilmenite is achieved at 100 mesh (0.147 millimeter). Microscopic examination indicates tiny inclusions of ilmenite in magnetite which cannot be liberated by grinding. The following analysis is for high grade laboratory samples of magnetite concentrate: Fe, 68.5 to 70.1 percent; TiO_2, 1.65 to 0.45 percent; and V, 0.50 to 0.70 percent.

Thus microscopic inclusions of hematite and less frequently of magnetite occur in ilmenite lowering the TiO_2 content of the high grade ilmenite samples from the theoretical 52.6 percent TiO_2. Highest grade laboratory samples of ilmenite concentrates assayed 47 to 48.5 percent TiO_2.

Concentration of Otanmäki ore was studied on a laboratory scale for several years; primarily in the Mineral

Second Otanmäki Staff Article

This is the second and final series of articles written exclusivly for MINING WORLD by Otanmäki's engineering staff.

The first articles which appeared in the August 1956 issue described the company and its importance to the economy of Finland, the discovery and geology of the ore bodies, and the shrinkage stoping mining operations.

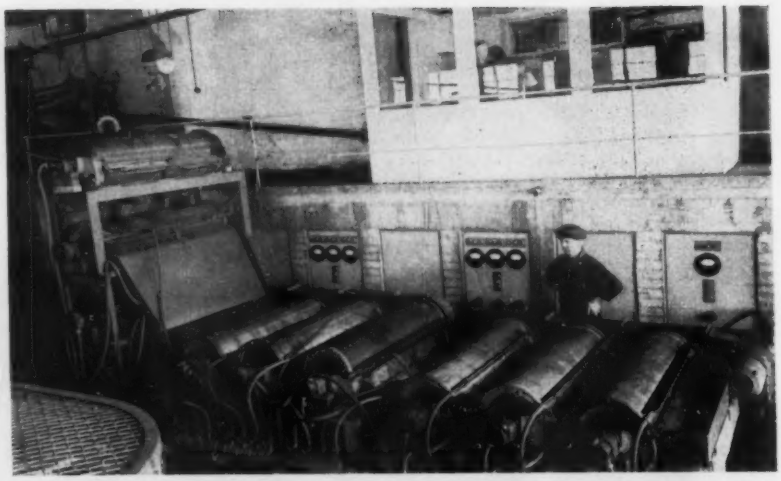
1. Aktieselskapet Titania, Joh. Lenschow, *Tidskrift for kjemi, bergvesen og metallurgi*, nr. 26, 1950.
2. Metallurgy at National Lead Company, McIntyre Development, Frank R. Milliken, *Mining Technology*, May 1948.

Dressing Laboratory of the State Institute for Technical Research in Helsinki. A pilot plant based on laboratory investigations was built at Otanmäki in 1949. Its capacity was about 1.0 ton of ore per hour. The following important observations were made during the test runs in the laboratory and pilot plant:

1. Cobbing can be advantageously applied down to a particle size of ¼-inch. Even at this size the ilmenite losses are about equal to the losses at coarser sizes.
2. In practice, the limiting lower size for dry cobbing is about 0.6 inch due to the moisture content of the feed.
3. Rod mill feed may be further concentrated by wet cobbing.
4. In the rod mill discharge ilmenite is largely liberated. Magnetic separation of rod mill discharge would result in less than 50 percent recovery of ilmenite in magnetic concentrate. Separation in this stage is not practical.
5. Of the various magnetic drum and Crockett-type separators tested in the final separation of magnetite concentrate, the drum separator operated in countercurrent fashion yielded the best overall results.
6. Fine grinding required for good liberation of magnetite and ilmenite makes concentration of ilmenite by tabling difficult. Grade of the table concentrate remains low and recovery is poor (less than 65 percent).
7. Concentration of ilmenite by flotation appeared to be the most promising method. Satisfactory grade (44 to 47 percent TiO_2) could be obtained with a recovery of more than 75 percent based on flotation feed. Substantial but unavoidable loss of ilmenite resulted in desliming of the pulp before flotation.
8. Various combinations of foreign and domestic reagents for flotation of ilmenite were studied in the pilot plant. Best results were obtained with a domestic refined tall oil rich in oleic and linoleic acids and relatively low in resin acids. Good results pre-suppose sharp elimination of slime and proper conditioning of the pulp with reagents.

Designed From Test Results

Based on testing results the Otanmäki concentrator was planned as follows:



MAGNETIC SEPARATION forms first step in concentration of Otanmäki ore. This unit has three rougher and six cleaner drums. The drum type separator used with countercurrent flow yields almost a 100 percent magnetite recovery.

The ore is crushed in open circuit in three stages, the first underground, the second and third on the surface. Between the second and third step, minus-0.6-inch fines are removed by screening and the screen oversize is sent to magnetic cobbers; only the magnetic fraction is reduced in the third crushing step. Combined screen undersize and final crushed product constitute the feed to the concentrator.

In the concentrator, wet cobbing of the feed takes place before grinding. The magnetic fraction is ground in a conventional rod mill-ball mill circuit to 10 percent plus-65-mesh. Magnetite is separated magnetically. From the nonmagnetic tailing, the small amount of pyrite is first separated by flotation. Ilmenite is floated after desliming in the second circuit. The concentrates are thickened, filtered, and conveyed to open air storage.

The crushing plant was designed to have:

- Initial maximum crushing capacity of 300 metric tons of ore per hour.
- Maximum conveying capacity of 500 metric tons per hour.
- Open-circuit crushing and screening.
- Easy control of all major equipment by a single operator.
- Easy access to the equipment by a single overhead crane.
- Provisions for doubling the capacity by installation of new equipment within the space initially available.

The ore is received in the 600 ton headframe bin from underground at minus-8-inches. From the bin it is fed by a vibrating grizzly-type feeder to a 5½-foot Symons standard cone crusher set at 1.2 inches. Crushed ore is conveyed to a splitter and fed by two vibrating chutes to two double deck 48 by 120 inch eccentric-type vibrating screens. The openings in the screen decks are 1.2 by 1.5 inches and 0.6 by 0.8 inches. Fine screen undersize forms a part of the final crushing plant product.

Screen oversize is treated by two parallel series of two 24 by 54 inch cobbing magnets. The tailing from the first cobbers is retreated on the second cobbers. Combined nonmagnetic tailings form lump waste which is conveyed by a 20 inch rubber covered steel conveyor belt to a height of 30 meters and stored in an open air pile with a capacity of 50,000 tons.

All magnetic products of cobbing magnets are collected and fed by a 31 inch conveyor to one of the two 5½ foot Symons short head cone

Table No. 1
Analytical Comparison of Magnetite-Ilmenite Ores

Mine	Principal Minerals In Percent: Magnetite	Ilmenite	Percent Other Minerals		Percent Analyses: Fe	TiO_2	FeS_2	V
Otanmäki Finland	35	28	37		40.0	15.5	1.0	0.26
			Including:					
			Plagioclase	7				
			Hornblende	17				
			Chlorite and mica	12				
			Pyrite	1				
A/S Titania Norway	5	35	60		20.0	17.0	—	—
			Including:					
			Plagioclase	35				
			Pyroxene	25				
National Lead Co. United States	37	32	31			16.5	—	—
			Including:					
			Feldspar	16				
			Iron silicates	15				

crushers set at 0.4 inch; the second being a spare. The crushed product and screen undersize mentioned above are collected on a 31 inch rubber covered steel belt and conveyed to the 3,000 ton concentrator bin.

All crushing machinery is operated from a separate control table with pilot lights, push buttons for starting and stopping, kW-meters for crushers, ampere-meters for direct current, and the respective rheostats. Machinery can be started in a definite order only. If any of the machines stops for any reason, all preceding machinery will stop automatically except the crushers. The machine causing the failure is observed immediately. Parallel circuits may be operated separately or together under the same automation.

Three men are required to operate the crushing plant. One takes care of the machinery, one operates the vibrating feeder and picks steel and wood coming from underground, and one is a cleanup man. One of his duties is to take care of the conveyor belts.

Table No. II
Results of Magnetic Cobbing at Otanmäki

Product	*Concentrate Percent*	*Tailing Percent*
Hand-picked magnetic particles, weight	96.2	0.3
Hand-picked nonmagnetic particles, weight	3.8	99.7
Magnetite, analyzed	37.4	1.6
Fe	41.7	12.4
TiO_2	16.7	4.3
Recovery, magnetite	95.9	4.1
Recovery, ilmenite	79.0	21.0

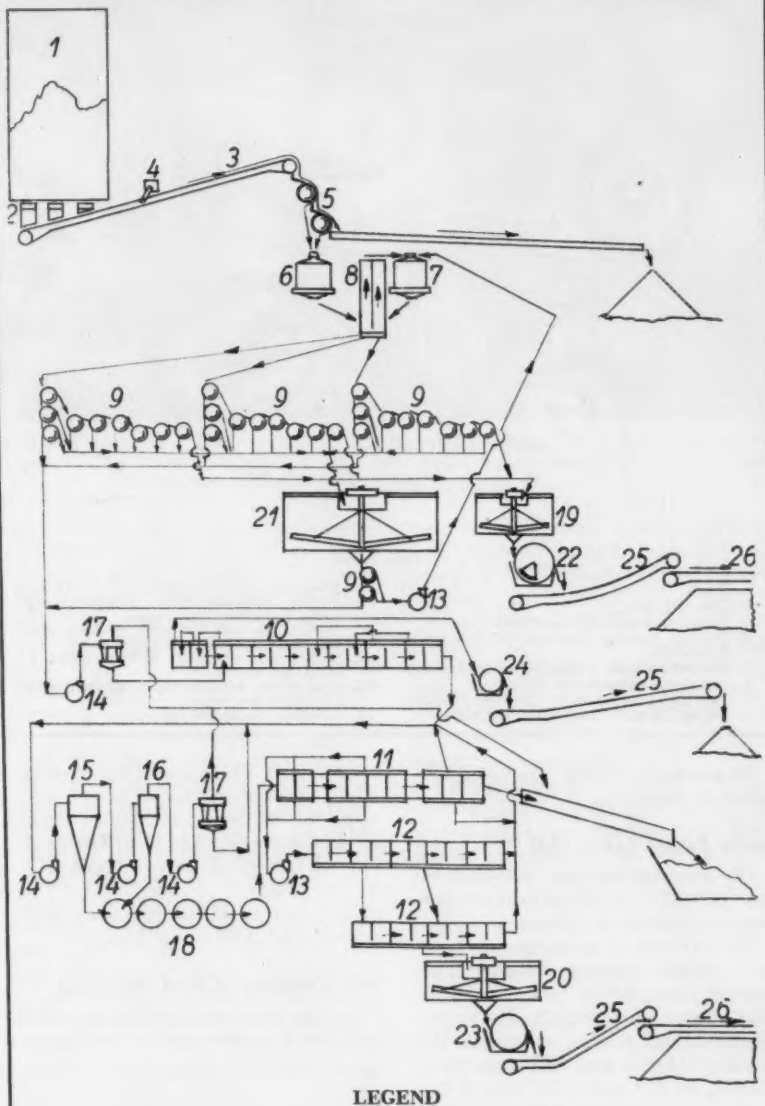
The two rubber covered steel conveyor belts carrying crushed ore and lump waste from the crushing plant are the first such conveyors installed in Finland. They have given excellent service. Steel belts are superior to ordinary rubber belts in cases where high tensile strength is required. Thus the belt between the crushing plant and the concentrator is driven by a single pulley instead of the tandem drive which would have been necessary for an ordinary belt.

Initially the vibrating grizzly-type feeder used to feed coarse ore from the 600 ton bin to the Symons standard crusher caused considerable trouble. Great variations in the ore size and moisture content caused equally great variations in the feed rate. The trouble was remedied by installing a pneumatically operated gate which controlled the amount of material flowing from the bin to the grizzly. Steel and wood are picked from the grizzly after stopping. During each shift 10 to 20 pieces of steel have been recovered as well as a considerable amount of wood.

The magnetic cobbing results have been very satisfactory. Magnetite content of the nonmagnetic tailing has been 0.1 to 1.6 percent and the TiO_2 content 4 to 5 percent. The average recoveries of magnetite and ilmenite by cobbing are 96 and 80 percent respectively. The amount of nonmagnetic material separated out is 20 percent, or 125,000 tons from the 625,000 tons of ore broken annually.

Because mining is underground the crushing plant feed may, occasionally, contain substantial amounts of slime. The loss in the nonmagnetic lump waste product is partially due to fine ore adhering to the surface of the larger nonmagnetic particles.

FLOWSHEET
Otanmaki Magnetite-Ilmenite Magnetic-Flotation Mill

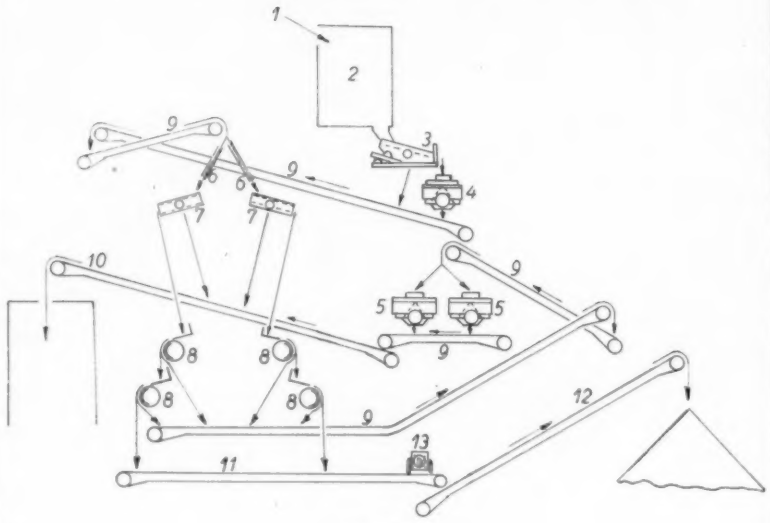


LEGEND

1. Bin, 3,000 tons.
2. Three hoppers and belt feeders.
3. Belt conveyor, 32 inches wide.
4. Adequate Weightometer.
5. Magnetic cobber separators.
6. Rod mill, 9 by 12 foot.
7. Ball mill, 9 by 12 foot.
8. Dorr-Duplex FX classifier.
9. Magnetic separators, 16 by 56 inches.
10. Rheinhausen flotation cells.
11. Fagergren flotation cells.
12. Knapp & Bates flotation cells.
13. Wilfley pump, 4-inch.
14. Wilfley pumps, 6-inch.
15. Cyclone, 30-inch.
16. Five 10-inch cyclones.
17. Three groups of 4-inch cyclones.
18. Conditioning tanks, 6 by 6 feet.
19. Thickener, 14-foot.
20. Thickener, 21-foot.
21. Thickener, 28-foot.
22. Magnetic drum filter.
23. Drum filter, 5 by 8 foot.
24. Drum filter, 3 by 4 foot.
25. Rubber belt conveyors, 20-inch.
26. Steel-rubber belt conveyors, 20-inch.

FLOWSHEET

Otanmaki Magnetite-Ilmenite Crushing Plant



LEGEND

1. Shaft.
2. Bin, 600 tons.
3. Vibrating feeder, 2-inch grizzly.
4. 5½-foot Symons Standard Crusher set at 1.2-inches.
5. 5½-foot Symons Shorthead set at 0.4-inch.
6. Vibrating chutes, width 32-inches.
7. Two deck screens, 48 by 120 inch, apertures 1.2 by 1.5 inches and 0.6 by 0.8 inches.
8. Magnetic cobber separators, 24 by 54 inch.
9. Rubber belt conveyors, 32-inches wide, speed 1.0 meters per second.
10. Steel-rubber belt conveyor, 32-inch, speed 1.6 meters per second.
11. Rubber belt conveyor, 20-inch, speed 1.0 meter per second.
12. Steel-rubber belt conveyor, 20-inch, speed 2.2 meters per second.
13. Adequate Weightometer.

Magnetic cobbing results are shown in Table No. II.

Easily Expandable Mill

The concentrator was designed to treat 500,000 tons of crushed ore per year from which is recovered:

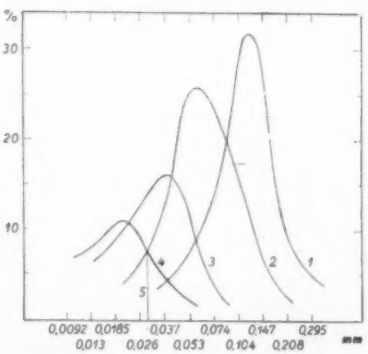
175,000 tons of magnetite concentrate, 80,000 tons of ilmenite concentrate, and 4,000 tons of pyrite concentrate. However in 1955 designed capacity was exceeded by treating 514,955 tons and recovering 184,474, 84,974 and 4,339 tons of respective concentrate.

The flow sheet is characterized by simplicity of design, large units, and gravity flow. Expansion in the future to double capacity can be simply done by extending the mill building, and by installation of certain new equipment. Such items as filters and storage facilities are already installed to handle 1,000,000 tons of feed annually.

The cylindrical, 12 by 20 meter, mill bin has an effective capacity of 3,000 tons. From it the ore is fed through three bottom openings to three short belt conveyors and then to a common conveyor feed belt. The feed rate is controlled by an Adequate-Weightometer. A test in which the rate of feed was checked at 10 minute intervals indicated the average deviation of the mean to be 1.3 percent, the maximum deviations being minus 4.4 and plus 2.6. The Weightometer is calibrated once a week and its "O" value is adjusted daily. The mean error in idling has been 0.35 percent and 1.06 under load.

Wet Cobbing of Rod Mill Feed

As was mentioned earlier, wet cobbing could be extended at least down to ¼-inch feed. In a preliminary trial the entire rod mill feed was fed with water to a 23 by 55 inch magnetic drum separator. The results indicated that 10 percent of the feed could be rejected this way before grinding. The nonmagnetic tailing assayed 3 to 5 percent magnetite and 7 to 9 TiO_2. As the preliminary run was encouraging, the rod mill feed in the future will be concentrated on two permanent magnetic separators in series, where the tailing of the first separator will be retreated on the second separator.



MAGNETITE CONCENTRATE grade variations with changes in wash water and strength of magnetic field. Curve No. 1 results from a weak field with much water; No. 2 from a strong field with much water; No. 3 from a weak field and little water; and No. 4 from a strong field and little water.

Grinding is done in a conventional rod mill-ball mill circuit consisting of two identical 9 by 12 foot overflow mills, the ball mill being in closed circuit with an 8-foot Dorr classifier. Each mill may be driven at 15.5, 17.8, or 20.3 revolutions per minute representing critical speed values of 57, 66, or 75 percent by changing the gears in the transmission box. Data for the mills are given in Table No. III.

Table No. III
Otanmäki Rod and Ball Mill Data

	Rod Mill	*Ball Mill*
Size, feet	9 x 12	9 x 12
Motor, kW	550	550
Revolutions per minute	15.5	17.8
Rod and ball load, tons	30	30
Rod and ball size, inches	3.2	1.2
Percent solids	70	60
Energy drawn at 70 tph, kW	270	260
Rod wear, grams per ton	300	—
Ball wear, grams per ton	—	300
Discharge, percent 200 mesh	21	30

Feeding the rod mill is accomplished by gravity fall of the ore directly through a 12 by 14 inch pipe inside the feed-end trunion. The pipe is supported by the feeding chute and leakage of pulp is prevented by a labyrinth and tallow seal. The ball mill is provided with a double scoop feeder.

The mills are lined with short liner plates, all of equal length. The plates are arranged in three rings. Outer rings are fastened by end plates and two special wedge rings, between which the middle ring rests. The wedge rings are held in place by bolts.

In the initial lining of both mills 1-inch dry wooden strips were placed between liners and lifter bars. Due to swelling, the lining became very tight. Experience has indicated that this method of lining is satisfactory in the ball mill. As soon as the wood is partly worn, the groove formed is filled by a protecting string of small balls. In the rod mill, however, rapid

wear of wooden strips was observed. When the mill was relined, only ¾-inch wide strips were used. Partially worn rod mill liners and lifters bars are used in the ball mill.

Magnetic Separation

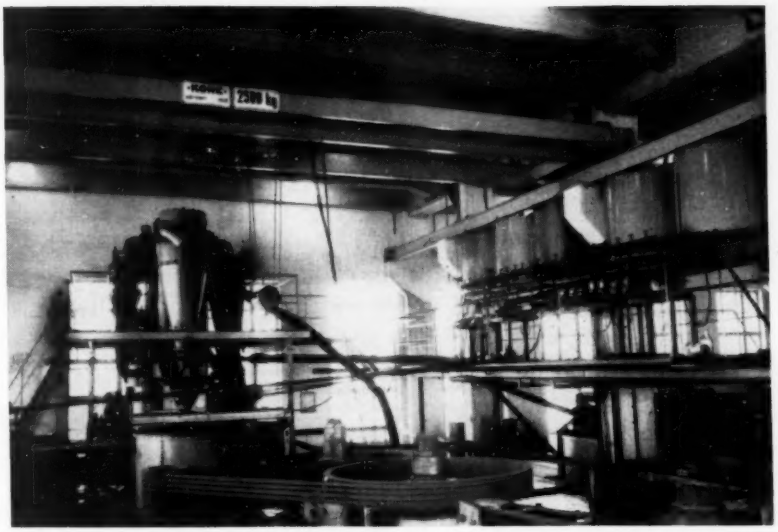
Magnetic separation of magnetite forms the first step in concentration. Practically a 100 percent recovery of magnetite is necessary, because the remaining magnetite would otherwise be floated with ilmenite thus lowering was grade of ilmenite concentrate. In view of the fact that locked particles of magnetite and ilmenite do occur, a compromise has to be made so as to keep the grades of both magnetite and ilmenite concentrates within marketable limits.

For separation of magnetite, 30, 16 by 55 inch drum separators were ordered. The drums were first arranged in 10 parallel series of three drums each. With this arrangement neither the magnetite tailing nor the concentrate were clean enough. For this reason the drums were regrouped as shown in the accompanying diagram. In the latter arrangement, rougher concentrate is obtained primarily from the top drum. Its tailing is retreated twice on the two drums underneath. Rougher concentrate is given six consecutive cleanings. All cleaner tailing and the concentrate from the two scavenger drums are combined and form a middling, which is thickened and reconcentrated in a special middling circuit consisting of two drums in vertical arrangement. The concentrates from all drums are combined and split between the three primary circuits; the tailings are sent to pyrite flotation. Thickener overflow contains slime relatively high in ilmenite and is discarded.

The new arrangement consistently has given a low tailing and a satisfactory concentrate. Its basic principle is the same as that applied to most flotation circuits. The novel features in the magnetic circuit in the Otanmäki concentrator are the grouping of large number of drums into three parallel systems; unusually heavy tonnage handled by the rougher drums; vertical downward flow of pulp over the roughers; multiple cleaning of the primary rougher tailing, and multiple cleaning of the primary rougher concentrate.

In the primary drums, field strength is kept at maximum of 15 amperes. In the cleaners it is lowered to 5 to 7.

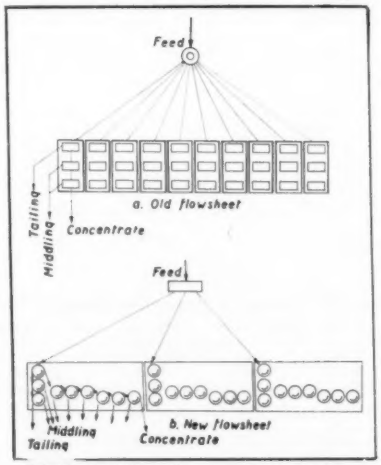
Extensive tests have been conducted regarding the flow of pulp in the magnetite drum separators. In the primary separators, the flow is in the direction of rotation. It allows large variations in consistency, in particle size, and in amount of the pulp treated. The cleaner drums are counter current machines which in general give lower tailing than the other type, but require rather uniform operating conditions to stay open.



CYCLONES make a sharp separation of slimes in the flotation feed. Separation takes place at about 29 microns with the slime feed to flotation containing 15 to 17 percent TiO_2. Note Clarkson reagent feeders along wall at right.

The feeds to the top, middle, and bottom primary drums carry 40 to 45, 10, and 2 percent magnetite, respectively. The final tailing assays 0.2 to 0.4. The final magnetite concentrate carries about 90 percent magnetite assaying over 65 percent Fe. See Table No. IV for screen analysis.

The effect of field strength and wash water on cleaning of primary rougher magnetite concentrate is shown by graph. It is seen that the amount of wash water has an unusually strong influence on the grade of the concentrate, even stronger than that of changes in the magnetic field. Best concentrate can be obtained at weak field with generous washing.



REGROUPING of magnetic separators as shown below increased recovery compared to results from original flow sheet shown above.

Complete mill results for 1955 are given in Table No. V. The magnetite concentrate assayed 65.9 percent Fe and 4.75 percent TiO_2. The minus-200-mesh fraction carries 69.8 percent of the total titanium content of the magnetite concentrate.

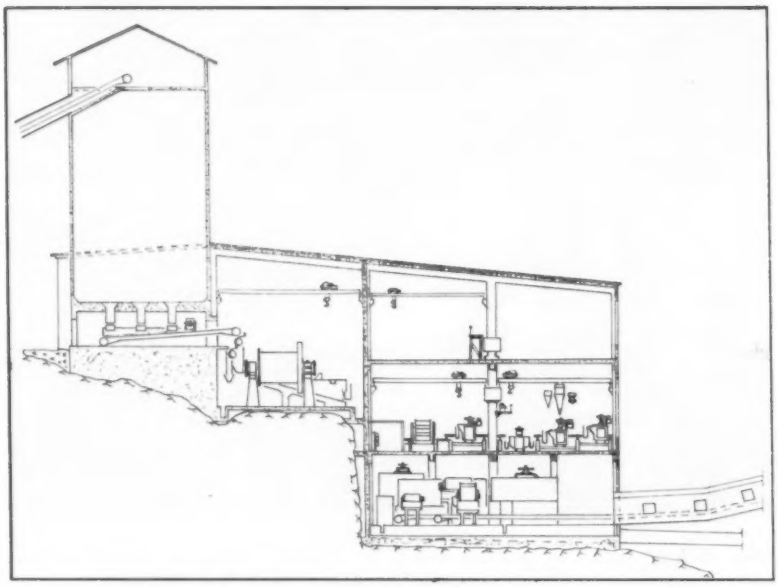
Classification experiments have indicated that titanium rich slime can be separated from magnetically flocculated magnetite concentrate. Accordingly in practice there is: generous use of washing water in the cleaner drums as mentioned before; thickening of magnetite circuit middling is done in a small thickener. At present, an 8 meter thickener is used for the middling. The slime overflow carries only 0.2 percent magnetite but 21 percent TiO_2 and is discarded.

Flotation of Pyrite

The small amount of pyrite in the ore must be removed before flotation of ilmenite. The pyrite flotation circuit is conventional. Flotation takes place in mechanical cells manufactured by Stahlbau Rheinhausen. Reagents and quantities used are: potassium ethyl xanthate, 125 grams per ton; domestic frother, 25 grams per ton; and sulphuric acid, 15 grams per ton. pH is 5.0 to 5.3. Concentrate grade is about 47 percent S with 70 percent recovery.

Flotation of Ilmenite

The very strict specifications for ilmenite concentrate call for a grade



ELEVATION of the Otanmäki mill showing arrangement of machinery.

higher than 44 percent TiO_2. When it is kept in mind that the highest grade of ilmenite ever produced on a laboratory scale at Otanmäki assays about 48 percent TiO_2, the 45 percent concentrate represents a degree of purity of 94 percent which even in the field of "easy" sulphide flotation is hard to obtain.

First step to secure the necessary grade is desliming of the feed to the ilmenite circuit in Driessen cones. The system at first installed included one 30-inch primary cone followed by 36 small 4-inch secondary cones in six parallel groups. Both were run with 6-inch Wifley pumps at pressures of 0.5 and 2.5 atmospheres respectively. As ilmenite flotation requires sharp elimination of slime, the cyclone discharge had to be maintained at a density of about 70 percent solids. At that density it became difficult to keep the small cyclones open. Plugged cones discharged everything into the slime which in the open circuit arrangement resulted in a heavy loss of ilmenite.

Improvement was sought with a three-step desliming circuit. The 30-inch primary cone then separated the bulk of coarser material. The slime fraction was pumped to a group of 10-inch cones. This group includes five cones of which three or four are in operation at any time. The slime from the secondary cones was repumped to three groups of six 4-inch tertiary cones. Their underflow at 30 to 40 percent solids was combined with the feed to the primary cone; their slimes were the final slimes to be discarded. The triple circuit system has given more satisfactory performance than the former two-step system. The latest change, just recently finished, has been replacing of 10-inch and 4-inch cones with 3-inch units and the installation of a densifier between desliming and conditioning. The 3-inch cyclones increase the solid recovery and the densifier feeds a thick pulp to the conditioners.

To give trouble free service, the cones require constant amount of feed, constant pulp density, constant pressure, and nonwearing parts. Such conditions are impossible to maintain in practice. Therefore the use of cones as the sole desliming apparatus remains more or less unsatisfactory. Separation takes place at about 29 microns and the slime contains 15 to 17 percent TiO_2.

Underflow from primary and secondary cones is sent to a series of conditioning tanks for a total conditioning time of 20 minutes. Conditioning takes place in a neutral circuit. As the feed to the ilmenite circuit has a pH of about 5.4, little soda ash must be added. As a collector domestic tall oil is used. Due to the high humic acid content of the mill water, the amount of tall oil necessary is quite high, 1.1 to 1.3 kilograms per ton of mill feed. The humic acids are strong depressants, increase reagent consumption, decrease recovery, and make long conditioning necessary. In the cleaner circuit the use of additional collector has become obligatory.

In the rougher circuit, the pH is dropped by sulphuric acid to 4.8 and in the cleaners to 4.5 to 3.0. As the pH control is of primary importance, a continuously recording Leeds & Northrup pH-meter system with six

Table No. IV
Analyses of Otanmäki Magnetite Concentrate

Screen		Weight	Iron	TiO_2	
Mesh	Millimeters	Percent	Percent	Percent	Distribution Percent
	0.485	—			
	0.223	0.39	29.1	4.6	0.4
	0.175	0.71	48.1	6.0	0.7
100	0.147	2.05	60.0	5.0	1.7
150	0.104	15.50	65.8	4.5	12.3
200	0.074	19.20	67.1	4.5	15.1
—200	—0.074	62.15	66.4	6.4	69.8
Total		100.00	66.03	5.70	100.0

Table No. V
Operating Results Otanmäki Magnetite-Ilmenite Mill for 1955

Product	Fe_2O_3 Percent	Fe_2O_3 Distribution, Percent	Fe Percent	TiO_2 Percent	TiO_2 Distribution Percent	S Percent	S Distribution Percent	V Percent	Co Percent	H_2O Percent
Mill feed	32.7	100.0	38.53	14.06	100.0	0.66	100.0	0.26	—	1.17
Magnetite tailing	2.5	0.4	15.28	5.47	2.0	0.54	4.2	0.08	—	—
Rod mill feed	33.7	99.6	39.21	14.24	98.0	0.69	95.8	0.27	—	—
Magnetite concentrate	89.0	98.3	65.90	4.75	12.1	0.16	8.7	0.55	—	8.75
Pyrite concentrate	—	—	43.28	0.56	0.03	48.62	61.9	0.00	0.72	9.14
Ilmenite concentrate	1.5	0.8	36.58	44.28	52.0	0.10	2.50	0.17	—	6.47
Tailing	0.4	0.5	16.40	9.23	33.9	0.27	22.7	0.07	—	—

Speedomax recording instruments has been installed.

The ilmenite tailing is continuously analyzed on a Denver visual sampler pilot table. Its use has been of considerable help in the operation of ilmenite roughers.

Rougher flotation takes place in Fagergren cells and cleaning in British-made Knapp and Bates cells of the Denver Sub-A type. The rotors and stators of Fagergren mechanisms were first covered with neoprene to withstand the effect of fatty acids. It was soon discovered that tall oil attacks neoprene. Since, rotors and stators are made of cast iron.

Filtration

All concentrates are filtered on drum filters manufactured in Sweden by Sala Maskinfabrik Ab.

An initial feature at Otanmäki was the magnetic filter unit used for magnetite. Inside the drum there was a series of magnets which cause magnetic flocculation resulting in increased adherence of the concentrate to the filter surface forming a thick filter cake and increasing filter capacity. This drum was the second such unit ever installed.

Now, however, magnetite concentrate is filtered with an ordinary drum filter. The filter cake is about 1.5 percent drier than with the magnetic filter. The capacity of the ordinary drum filter is up to 4.0 tons per hour per square meter and at least as high as the capacity of the magnetic filter. The magnetic filter is used only as a reserve filter. Perhaps magnetic filtering has its advantages when the magnetite concentrate is more coarse than that at Otanmäki..

Table No. VI
Otanmäki Mill Consumption of Electricity for 1955

Section	*kWh per Crushed Ton*	*kWh per Ton of Mill Feed*
Crushing	1.29	1.60
Grinding	7.18	8.90
Magnetic concentration	0.78	0.97
Flotation of pyrite	1.49	1.85
Flotation of ilmenite	3.85	4.78
Dewatering	1.72	2.14
Storage	0.08	0.10
Water	2.02	2.51
Lights, etc.	0.43	0.53
Total	18.84	23.38

Storage

Magnetite, ilmenite, and pyrite concentrates are stored in open air piles having a total length of 300 meters. Filtered concentrates are conveyed and distributed by rubber covered steel belts. Magnetite and ilmenite concentrates can be removed from the belt at any point by a scraper mechanism which feeds into a hopper which discharges the concentrate in 100 to 200 kilogram batches to prevent wind loss. Concentrate adhering to the belt surface is removed by a cleaning scraper placed immediately after the tail pulley.

Concentrates are loaded to railroad cars by a 1.5 cubic meter Weserhütte No. 12 shovel during the shipping season. Storage facilities are provided for six months' production.

To operate the crushing plant in two shifts and the concentrator in

This chapter continued on page 96 (WM56)

Salt Roast, Hot Water Leach, and H_2SO_4 Precipitation Recover V_2O_5

By MARTTI MERENMIES
Vanadium Plant Superintendent

Vanadium was recovered for the first time commercially from Otanmäki ores in June 1956. From the start of operations it was known that vanadium occurred with the magnetite in the ore and that the magnetite concentrate averaged 0.5 percent vanadium.

Laboratory test work to find an economical method to recover this vanadium was carried out from 1952 to 1954. Work was successful and a pilot plant to use a newly developed separation process was built in 1954. The commercial plant employs the following process for vanadium recovery: Dried magnetite concentrate is mixed with a sodium salt and reground in a ball mill. Resultant pulp is pelletized in a drum. With the aid of a proper amount of water, about 1-inch diameter balls are rolled and fed into a pelletizing furnace. This is a round shaft furnace especially designed for the reactions between vanadium and sodium. For this reason furnace construction differs noticeably from that of normal pelletizing furnaces. The burnt pellets are removed into a counter-current leaching system. Hot water is used as the leaching solution. The leach pregnant solution contains 16 to 20 grams per liter of vanadium in the form of sodium vanadate. The leached pellets are sold as high-grade iron sinter. The vanadium is precipitated from the pregnant solution with sulphuric acid as vanadic acid. This precipitate is separater from the solution in pressure filters.

By special methods the precipitate is purified before being fused and cast into flakes. In this form the product is delivered to the market as fused vanadium pentoxide, analysing as follows: V_2O_5, 90 to 92 percent; SiO_2, 1.0 percent; P, 0.01 percent; S, 0.01 percent; As, 0.01 percent; and Na_2O, 2.0 per cent.

After the pilot-plant stage (which lasted for 18 months) the construction of the vanadium plant proper was begun in 1955. Trial runs were started in June 1956 and production began in July 1956. Owing to the scale of operations it has been considered advantageous in the beginning to treat only one-half of the mill's magnetite concentrate for about one year, before full-scale production is undertaken. The building was constructed for full-scale production.

Production during the first stage is planned to be about 600 tons of fused vanadium pentoxide per year, a figure that will be doubled in 1957.

Finland is now in the European steel market as the first large-scale European producer of vanadium from its own ore deposits. In all countries producing high-grade steel this has aroused lively interest. Vanadium will thus, in all likelihood, contribute a welcome addition to Finland's otherwise rather one-sided range of export goods.

THE END

How Colored Stereoscopic Aerial Photographs Yield Ore Search Clues

In One Year $25,000 Will Pay For Aerogeological Exploration and Evaluation of Six Mining Districts

By PHILIP A. LAYLANDER
Consulting Geologist
Tucson, Arizona

New photographic techniques plus evaluation studies over a period of several years give more meaningful clues to location of western ore bodies.

In the June 1952 issue of MINING WORLD[1] I described the results of the first five years of a broad research project in the field of mineral exploration using large scale, vertical, stereoscopic, color aerial photography. The article described the methods used, and certain regional and district relationships of ore deposits observed in the study of dozens of mining districts in the Basin Range Province, including Nevada, Arizona, Western Utah, and western New Mexico. This region has probably a greater number of known and potential ore deposits than any comparable area in the world. The geology is possibly more complex than any area of its size.

This past four years a number of new areas were photographed and studied. Some quite detailed studies of districts were made. Some previously studied districts were rephotographed using unconventional color photographic methods and restudied. The unconventional photography is particularly valuable in supplying critical alteration information concerning some types of ore situations. It also aids materially in distinguishing rock faces which are very subtle with conventional color photography. Such information is often important for analyzing areas in ore search.

The type of such unconventional color photgraphy required for a particular area depends on the nature of the rocks and alterations. This is determined through experience and the picture given by the conventional color photographs. It involves the use of different types of film, different filter combinations, and changes in the standard processing.

There has been considerable opportunity the past nine years to compare the results of the color photogeologic approach in ore finding with ground methods. In speed, economy, and completeness of discernment of many important geologic features related to ore deposits in an area by which the ore situation can be analyzed and evaluated, the vertical three-dimension view often provides several times the efficiency of ground methods.

Stereoscopic Colored Pictures

The stereoscopic colored aerial photographs are in fact an almost infinitely detailed geologic relief map of an area, far more detailed and accurate than could be produced by the most exhaustive ground work. One difficulty in their use is that there is such a great amount of detail with delicate shadings and often subtle representation of important features that considerable experience is required to read the information and to distinguish the important from the unimportant. The handling of the distortions in scale and directions caused by topography requires some training in photogrammetry.

One measure of the value of the color photogeologic approach is that essentially every known ore deposit of any consequence in the Basin Range Province would have been discovered by that approach. Very few of the multitude of unprofitable developments would have been determined as valuable. This gives considerable confidence in the use of the methods in exploration.

One of the interesting observations is that nearly every mineralized out-

1. How Colored Aerial Photographs Make Newest Ore-Search Method, MINING WORLD, Vol. 14, No. 7, pages 41 to 43.

crop in the region has been located and prospected to some extent by *the* thousands of ground prospectors over the past hundred years, even in quite remote and inaccessible areas. Usually the prospector had little knowledge of the geologic setting or the ore potentials. A hundred foot shaft or few hundred foot tunnel was often the limit of exploration in situations which would require several times that amount of work in a different location.

The geologic picture of the Basin Range Province indicates that there are a great many ore situations in covered areas, particularly in the lower slopes of the mountain ranges—the pediment areas. Future exploration will involve, to a large extent, the selection of such favorable areas for detailed study, selecting specific targets in the areas, taking up the ground and doing required diamond drilling.

New aerial geophysical methods may develop into valuable tools for studying such areas. Both geophysical and geochemical methods will probably be most valuable in the detailed surveys of selected small areas with fairly well known geologic settings, rather than for broad scanning, particularly in regions comparable to the Basin Range Province. The prior photogeological analysis of the areas will be most useful in planning and conducting such operations.

There are considerations, other than the strictly technical and geologic, in the field of mining exploration which are very important to the development of such research projects as that which has occupied the writer the past nine years. It is possible that some comment on those general considerations and problems may have a salutory effect on the growth and development of comparable activities. In our expanding economy it is undoubtedly true that the necessary progress of the country will depend to a large extent upon the maximum amount of research of all types in the development of new methods and ideas in all fields of endeavor, including mining exploration. The creation of a favorable economic environment for such work is basic.

Qualified studies in recent years have indicated that in the field of mineral resources the United States will be at a serious disadvantage in a short time unless the discovery rate becomes higher than at present. It would seem desirable to have the discovery rate higher than the rate of consumption, since it is likely that foreign supplies will tend to decrease as the result of increasing nationalism in producing countries and increased consumption in Europe and other areas accompanying increased industrialization and improved standards of living.

This situation would seem to call for as full and early disclosure of information concerning new exploration methods and ore relationships found as result of research projects so that it could be put to general use.

Individuals and companies with a sense of social responsibility generally have a desire to disclose such information of potential value to the general development of the mineral exploration field. However, many major mining companies are indisposed to release information which might aid their competitors, particularly with respect to specific districts. Individuals and small companies in a relatively delicate financial position feel that they must retain their advantage in "know how" derived from investment of time and money in research projects to protect their possibilities for financial survival and eventual profit. They feel that they can afford to publish only such information as might assist in creating a favorable situation with respect to consulting or contract work or interest of financial participation in developing exploration leads by ground acquisition and testing by other groups.

Here's Discovery Proof

That important discoveries can be made in well known and accessible areas has been shown by the recent successes in the Mineral Hill district about 20 miles southwest of Tucson, Arizona. A vein and disseminated copper deposit discovered by the United Geophysical Company in 1951 was sold for $10,000,000.00 this past year. The publication of the exploration thinking and methods used in making the discovery was a valuable contribution to the literature on exploration.[2] In the summer of 1956 a report was published describing a porphyry copper discovery about 10 miles southwest of the United Geophysical's (Pima Mining Company's) property by the Duvall Sulfur and Potash Company. There was an estimated 80,000,000 tons of 0.8 percent copper ore with a production potential of about $400,000,000.00. The value of the property as a discovery is probably in excess of $10,000,000.00.

2. "Use of Geophysics Pays Off at Pima With Disclosure of Copper Ore Body," MINING WORLD, October 1954, pages 42 through 45.

PORPHYRY COPPER DRILLING in the southwest from the air. This photograph was made from aero-Ektachrome positive transparencies. Scale is about 1:7,500 (1"=625').

PIMA MINING COMPANY'S operations prove that there are still a number of opportunities for similar discoveries in the Basin Range Province.

Those two new discoveries, together with the potential production from the Banner Mining Company's development adjacent to the Pima discovery on the same structure will convert the Mineral Hill from a minor to a major district. The Basin Range Province presents a number of opportunities for such discoveries by those willing to try new exploration methods and follow new concepts concerning ore deposits derived from new lines of investigation. Intelligent discretion rather than conservatism will be the basis for successful exploration programs.

The writer first accomplished large scale, vertical stereoscopic color aerial photography of the Mineral Hill district in 1951. One of the promising targets determined by the photogeologic study of the district was the property successfully drilled by Duval. At that time (1951 to 1953) it was not possible to arrange financing to take up and test the ground. It was also not possible to have one of the major copper companies take up and test the ground on a participation basis. The initial testing of the Pima property had already begun. The value of that property would not have been estimated at the outset as result of the color photogeologic study. A program to drill the extension under the alluvium of the Banner mine shear fault of known mineralization would have been recommended. A careful placing of about six diamond drill holes would have found the ore. However, it is very doubtful that financing for such an activity could have been obtained from mining people.

What Restudy Proves

The district was restudied in connection with a consulting contract in 1953. It was rephotographed with unconventional color methods and restudied in 1956. This photography clarified a number of features which were not clear on the conventional color film. There are several theses and older reports covering parts of the district. The geologic picture given by the color photographs is considerably different from that of the theses and reports. This is true of many districts in the Basin Range Province.

The Mineral Hill district is very complex both in its broad features and details—which is characteristic of many districts in the Basin Range Province. There was a long period of thrust faulting with associated shearing followed by normal and reverse tension faulting preceding the period of ore formation. There has also been some normal faulting since formation of the ore deposits. Post-ore faulting, if present, is minor. The effect of faulting on the broad alteration areas, which can be seen to best advantage on the color photographs, is one method of distinguishing between pre- and post-mineral faulting. This type of observation is a good general guide for location of "lost" ore bodies, since such displacements are often large, and difficult to estimate on the basis of ground observations in complex areas.

The distribution of the basement complex units reflecting faults and structural trends, which may be important in the sedimentary strata areas where the ore occurs, can be seen to advantage with the color photographs. The distribution of possible intrusive features r lated to ore sources below the sedimentary sheet can be determined by their broad alteration effects, which are seen better on the color photographs than on the ground. The gradual fading of foliations in some of the basement complex units towards mineralized areas indicate broad metasomatic effects. Those can be seen much better on the color photographs than on the ground. Because of these and other lines of information seen to advantage, the colored aerial photographs make possible acquisition of an adequate working knowledge of a district for exploration purposes in considerably shorter time than ground studies.

Need To Apply New Ideas

Because the aerogeological methods, particularly the use of the vertical stereoscopic color aerial photography, give such a large amount of valuable information so efficiently they appear to be a logical basis for an exploration program. However, the writer has found considerable difficulty in selling the ideas to the mining companies. Much of that group seems reluctant to develop new methods and apply new ideas—more so than those in other industrial fields. Perhaps in the future with participation of new groups with initiative and willingness to try new things—such as some who have entered the mining exploration field through interest in uranium the past few years—it may be possible to undertake a program involving a limited budget, which will make possible the putting to an adequate test the methods and ideas for finding ore deposits developed the past nine years. A suc-

cessful program would encourage the initiation of a number of other programs using the methods, both in the Basin Range Province and other regions.

The experience of the writer indicates that at least five years of preliminary research in the applications of the aerogeological methods, and developing knowledge of ore relationships of a region which may be observed thereby, is an essential basis for such a program. It is possible to get some advantages very soon from the uses of the colored aerial photographs in geological studies. But it is a long step to obtain sufficient experience to make the rather difficult analyses and evaluations necessary to accurately judge the possibilities for ore in new or covered areas in a complex region.

To determine the increase in ability with experience in analyzing and evaluating areas photogeologically, some of the areas photographed and studied the first year were restudied the second, third, and fifth year. The photographs were about twice as meaningful each time they were restudied. Some of the areas studied again after nine years indicated approximately another doubling of the information. This type of increase with experience of ability to make discriminations and value judgments probably occurs also in other fields, such as geophysical exploration.

It seems most likely that profitable exploration campaigns based on the aerogeological approach can be carried out with sufficient background of experience in a region. Such programs must be set up on broad enough bases to permit study of a sufficient number of districts in a large enough region to result in at least one discovery by which the expenses of the program will be returned, with profit on the venture in proportion to the size of the discoveries. It should be possible to make a discovery comparable to the Pima or Duvall discoveries in the Mineral Hill district aforementioned, which would represent a large profit.

For an adequately large aerogeological exploration project, the $100,000.00 per year write off permitted in the tax laws is a reasonably good budget. If this amount were ventured by those in the higher tax brackets, with discovery of property which could be sold on a capital gain basis equal to the amount spent on a program, it would represent a real profit. The potential profits from mining operations due to the increased depletion allowance or many minerals is an additional incentive. With DMEA participation in the testing of properties in which the initial discovery were made by the aerogeological exploration—which might make available an additional $200,000.00 on favorable terms—the risk-profit ratio would be considerably improved. It is certain that for the forseeable future, all the incentives to exploration will not result in a surplus of discoveries over national requirements, for it is at best a very complex and difficult field.

Cost of Aerogeology

The aerogeological exploration program will require about $25,000.00 per year for airplane, cameras, field equipment, supplies, etc. The program should entail photography and photogeological study with field checking of about six districts per year. With best possible selection of districts, based on considerable prior study, and sufficient experience in analyzing and evaluating the information supplied by the color aerial photographs, about half of the districts studied will present targets for ground acquisition and testing. The targets should be such that at least one in four will result in discovery of ore. The targets selected should all be of sufficient size to warrant a modern mining and milling installation. A minimum size of potential production should be about $10,000,000.00.

The targets will require about 100 claims per year costing about $10,000.00 for staking and location work. The drilling necessary to test each target will require between six and 10 holes averaging about 500 foot depth, which will cost between $18,000.00 and $30,000.00 per target. The drilling might be accomplished for less in favorable areas.

Sometimes it will be desirable to photograph and study larger blocks of ground than the average mining district of 30 to 50 square miles. At present, the writer is completing the study of a 400 square mile area under a consulting contract, photographed last year on a scale of about 1:12,000. It is a remote area of very complex geology and little previous study. Another area studied a few years ago was about 150 square miles with photography at 1:9,000. The area photographed should be large enough to present enough of the rock—structure—alteration relationships necessary for analysis. Of course, there is seldom enough information available within one limited area for anything approaching a complete analysis. Relationships existing in the surrounding areas within perhaps 100 miles radius must be used as much as possible in completing the picture.

It is hoped that it will be possible in time to publish the details of completed studies in districts, possibly resulting in discoveries. However, that must depend upon the acquisition and testing of targets in the districts studied these past years, which has been the principal obstacle to date. It may be possible to publish something on observations of types of geologic features and possible relationships to ore before long. There is a scheduled publication of papers on photogeology including one by the writer in the December 1956 *Photogrammetric Engineering*. The papers were presented at the national meeting of the Photogrammetric Engineering Society in Washington, D. C. in March 1956.

It seems most likely that there will be a much greater application of photogeological, geophysical, and geochemical methods in ore search in the years to come, as the value of such work becomes more generally recognized. There will probably be much greater participation in the mining exploration field by new interests on a scale intermediate between the monolithic activities of the major mining companies and the very restricted activities of the individual prospectors. That work should be both productive and profitable if carefully and intelligently carried out.

THE END

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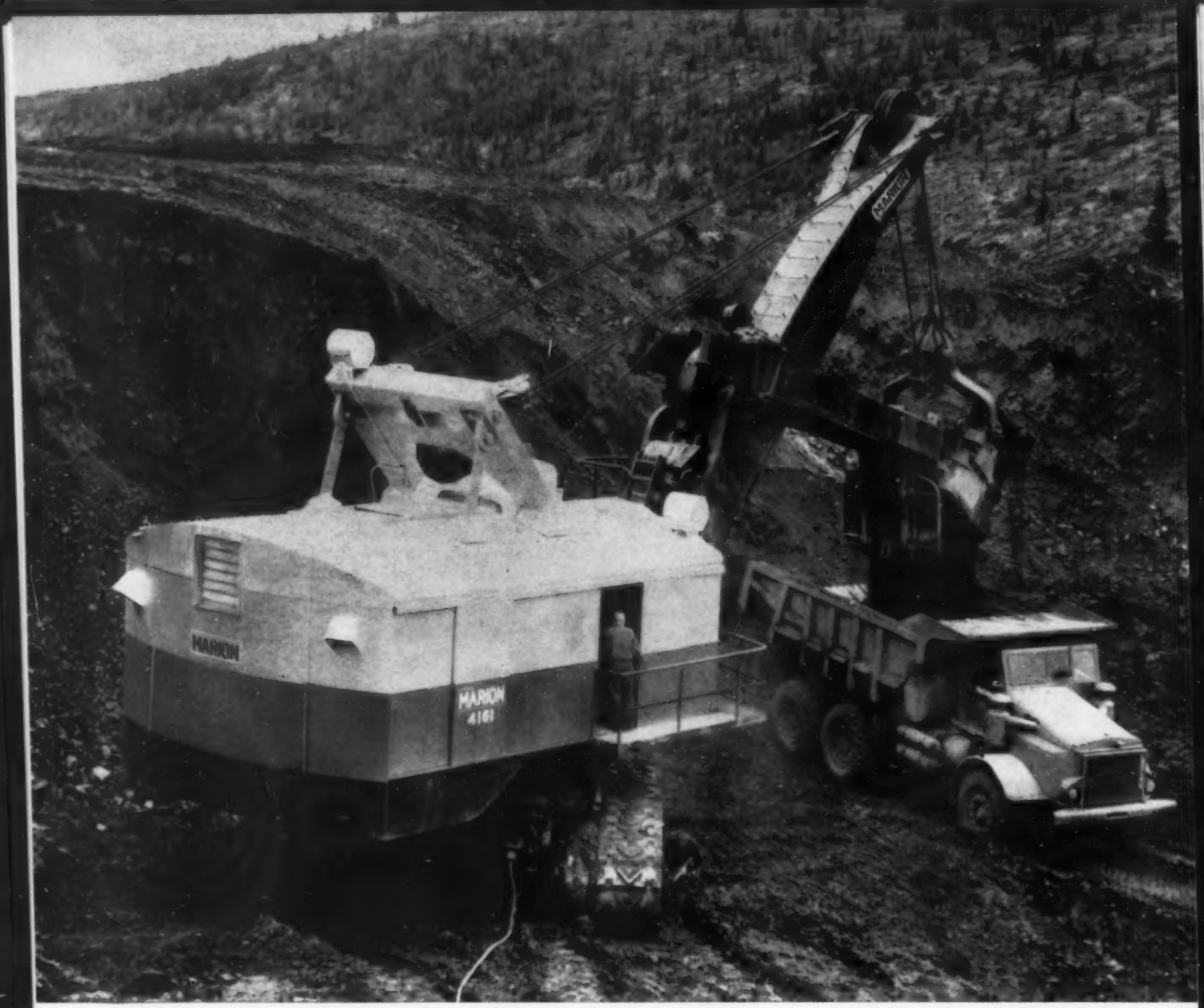

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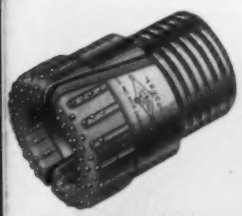
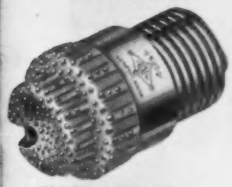
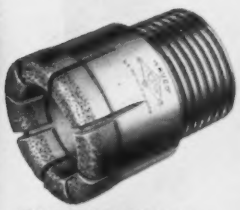


TRUCO CORING BIT

TRUCO CONCAVE BLAST HOLE BIT

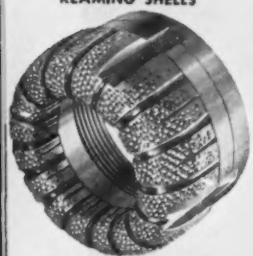


TRUCO PILOT BIT



TRUCO IMPREGNATED CORING BIT

TRUCO REAMING SHELLS



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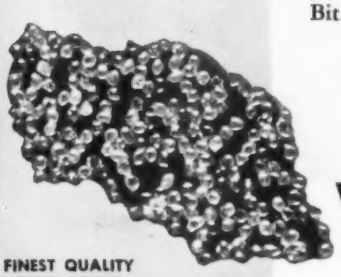

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Standard bits	.72	7′	33.3′
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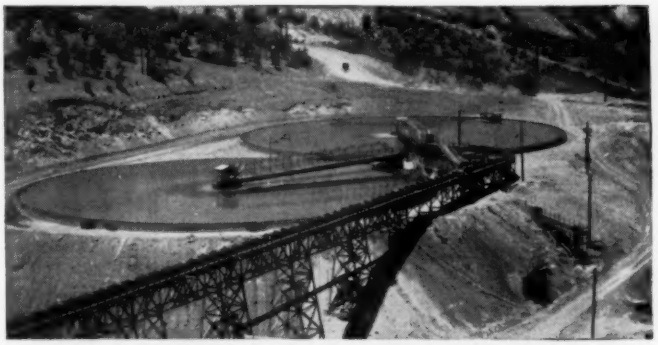

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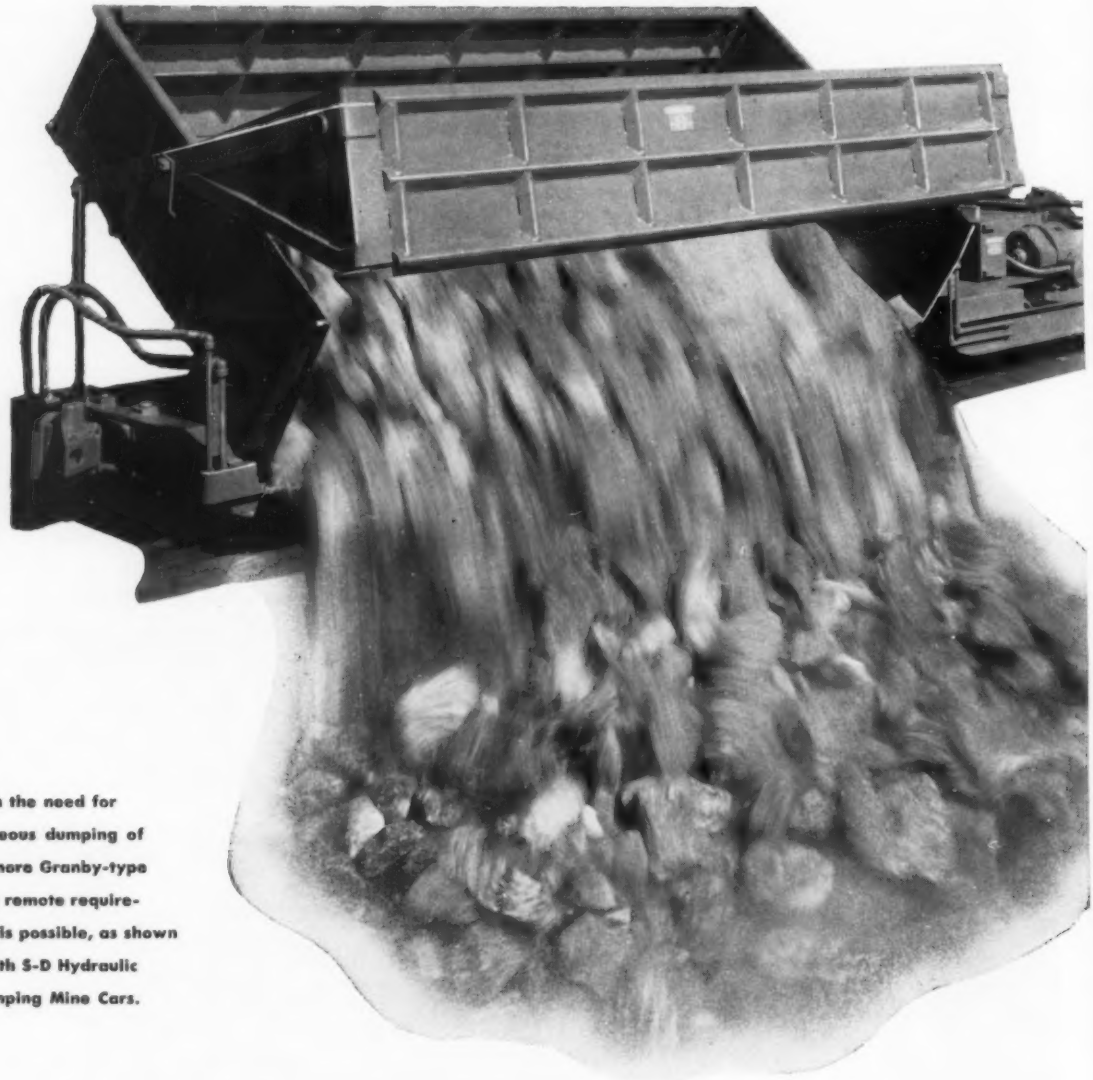

Although the need for simultaneous dumping of two or more Granby-type cars is a remote requirement, it is possible, as shown here, with S-D Hydraulic Self-Dumping Mine Cars.

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Is there something special you need in mine cars? You will probably find the answer in our plant

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No Fixed Dumping Point or Ramp Required!

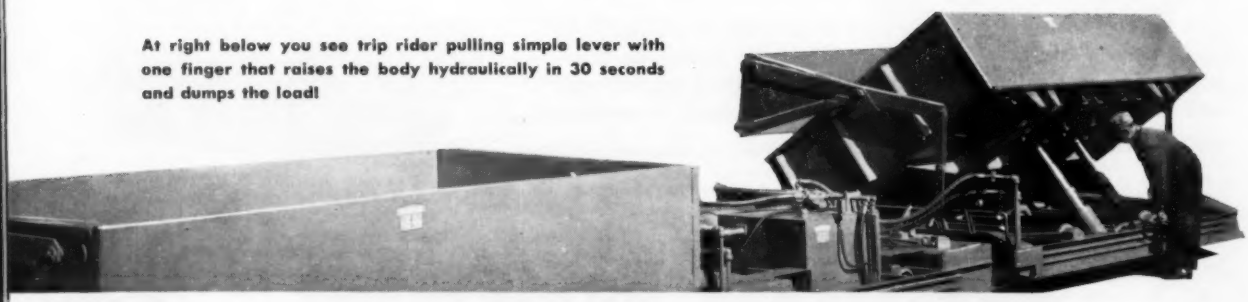
Twenty of these new cars were recently built for a large steel company to haul waste material out of mine development areas for disposal at outside ravines. The new S-D Hydraulic Self-Dumping Cars met the need for cars to operate in train and dump independently at any place. Of course, each car may be unloaded at the same fixed dumping point.

A pair of telescopic hydraulic cylinders raise the body to a dumping angle of 40 degrees. The trip rider selectively dumps each car by means of a lever located on side of underframe. Hydraulic power is supplied by a power unit mounted on a small car that is coupled in the trip. Hydraulic hoses connect the cars by means of quick-connect-and-disconnect self-sealing couplings. The car body raises or lowers in less than 30 seconds. Here is a car that could save you many man-hours and increase haulage efficiency if fixed dumping points are not practical or desirable. ***It is another example how cost-conscious mining men turn to Sanford-Day for the engineering know-how to help them successfully solve haulage problems.***

Each S-D Hydraulic Self-Dumping car pictured here has a 10-ton rock capacity, and is approximately 17 feet long, 7 feet wide and less than 4 feet high from top of rail.

Trip may be halted and each car dumped one-after-another, or, of course, trip moved on to each desired dumping point. Power unit car is normally located behind locomotive, although, as shown here, it may be coupled between cars.

At right below you see trip rider pulling simple lever with one finger that raises the body hydraulically in 30 seconds and dumps the load!



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This model R-40 is the newest addition to Euclid's complete line of Rear-Dump haulers. Built for jobs where big loads must be hauled, it incorporates all of the advance design features that have made "Eucs" the standard of performance for hauling heavy excavation in construction, mine, quarry and industrial service.

Two power trains—each with separate engine, 3-speed Torqmatic Drive and planetary drive axle—provide plenty of power to move capacity loads over tough haul roads and steep grades. The tandem axles are spring mounted to permit fast travel on good haul roads . . . the R-40 has a top speed of 26 mph with full payload.

Hydraulic booster steering makes this big Euclid easy to handle in close quarters and on tough hauls. Dumping angle of 67° and smooth interior of exhaust heated body assure quick, clean shedding of the load into hoppers, over the bank, or on the fill.

Your Euclid dealer will be glad to discuss the model R-40 and your off-highway hauling problems. He'll provide a production-cost estimate for present or planned operations, and can show you why ***Euclids are your best investment.***

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Personalities in the News——

The American Institute of Mining, Metallurgical and Petroleum Engineers has reorganized its structure to transform its three branches into the Metallurgical Society of AIME, the Society of Mining Engineers of AIME, and the Society of Petroleum Engineers of AIME. The new setup places the 30,000 members in the new Societies according to individual choices by the members. The Board of Directors of the Institute continues in control. Under the new bylaws adopted by the Board, the Metallurgical Society will consist of the Institute of Metals Division, Iron and Steel Division, and Extractive Metallurgy Division. The Society of Mining Engineers will consist of the Coal Division, Industrial Minerals Division, Minerals Beneficiation Division, and Mining, Geology and Geophysics Division.

The Metallurgical Society of AIME has selected the following provisional officers: President, **John C. Kinnear**, general manager, Kennecott Copper Corporation, Nevada Mines Division, McGill, Nevada; vice president, **Walter R. Hibbard, Jr.**, manager of Alloy Studies Research Laboratory, Schenectady, New York; secretary-treasurer, **Robert W. Shearman**, of New York.

The Society of Mining Engineers of AIME has named **Elmer A. Jones**, manager of the Southeast Missouri Mining and Milling Division of St. Joseph Lead Company, Bonne Terre, Missouri, as president. **Will Mitchell**, heretofore chairman of the Mining Branch of AIME, becomes past president of the Society. Mr. Mitchell is associate director of research, Allis-Chalmers Manufacturing Company, Milwaukee. **Arnold Buzzalini** of New York is the secretary for the new Society.

J. H. Buehler is retiring as general manager of the Bristol Silver Mines Company in the Pioche district of Nevada. He will be succeeded by **Byron S. Hardie**, exploration geologist for American Smelting & Refining Company at Tucson, Arizona.

Charles W. Yetter, formerly of Grand Junction, Colorado, has been named president of the Capitol Uranium Company at Farmington, New Mexico.

George W. Rust has joined the staff of the Pacific Coast Company as director of mining and exploration, with headquarters in San Francisco. He was previously with Bear Creek Mining Company, Kennecott Copper Corporation's exploration subsidiary, as senior geologist.

Robert F. Pettit has been appointed to the new post of chief engineer of American Smelting and Refining Company's Northwest mining department at Wallace, Idaho to integrate its engineering functions and organize a new engineering division. He was associate professor of mining engineering at Missouri School of Mines and, before that, planning engineer in the U. S. Atomic Energy Commission's Los Alamos, New Mexico laboratory. **G. J. (Jerry) Christian** was named mine superintendent of ASARCO's Galena mine west of Wallace. He will be in charge of all mining operations at the property under **Norman Visnes**, unit superintendent of the entire Galena mining and milling operations. Mr. Christian was superintendent of the company's Frisco mine.

Dr. Wesley O. Connor, Jr. has been chosen to be secretary of **Ranchers** Exploration and Development Corporation, Albuquerque, New Mexico.

E. F. Eidam has accepted the position of assistant to the general manager—maintenance, for Pacific Isle Mining Company, Minnesota. He was formerly associated with Snyder Mining Company in a similar position.

William B. Hall, general manager, has been elected president and general manager of Vitro Uranium Company, division of Vitro Corporation of America. **Richard C. Cole**, assistant general manager, has been elected vice president of the uranium division.

VINCENT D. PERRY has been elected a vice president of The Anaconda Company. Mr. Perry has been chief geologist for Anaconda since 1948, and joined the company in 1924 after obtaining his master's degree in mining geology from Columbia University.

E. M. Gilmore has been appointed assistant superintendent of the **Monroe** mine for U. S. Steel's Oliver Iron Mining Division. Prior to this appointment he held the post of district industrial engineer, and since joining Oliver in 1948 has held various positions in the mining department of the Hibbing-Chisholm district.

R. L. Logan has been appointed manager of the **Niagara Falls** electrochemical plant of the Potash Division, International Minerals & Chemical Corporation. Mr. Logan, who has been assistant manager of the Niagara plant since 1952, succeeds **Charles H. Berle** as manager.

Franklin H. Sharp has been named mill superintendent of Sunshine Mining Company in the Silver Belt of the Coeur d'Alene mining region, northern Idaho, to succeed **Wayne Gould** who has joined Dow Chemical Company at Midland, Michigan.

James L. Lake is the new general manager of Union Carbide Nuclear Company's Colorado Plateau Operations. He joined the company in 1941, when it was United States Vanadium Corporation, and stayed until 1947 when he became affiliated with U. S. Steel Corporation. He rejoined Union Carbide in 1952 as chief metallurgist and later served as manager of exploration and process development until his recent appointment as general manager.

Clifford E. Whitehead, secretary, vice president, and director of the Moki Oil and Rare Metals Company of Sante Fe, New Mexico, has been named vice president in charge of industrial and public relations for Ambrosia Minerals, Inc. **M. M. Key, Sr.**, of Cleburne, Texas, is the new executive vice president.

Dr. Frederick C. Kruger has been appointed chief geologist for International Minerals and Chemical Corporation, Chicago. Dr. Kruger, formerly with Reynolds Metal Company, will join the staff of International's mining and exploration department and will be primarily responsible for geological appraisals and the evaluation of new mineral discoveries.

Gilbert R. Griswold, mining engineer, has been admitted as a partner to the firm of Chapman & Wood, consulting mining engineers and geologists, Albuquerque, New Mexico.

Sheldon L. Glover has retired from his work as supervisor of the Division of Mines and Geology for the State of Washington, a position he has held for 12 years. He was supervisor of the Division of Mines and Mining from 1941 to 1945, and was assistant supervisor of the predecessor agency, the Division of Geology, from 1937 to 1941. He has been a professional geologist for 40 years. His home address is 517 O'Farrell Avenue, Olympia, Washington.

Arthur W. Griffith, former superintendent of the acid plant of National Lead Company's uranium concentrator, Grand Junction Operations Center of the U. S. Atomic Energy Commission, was recently named milling superintendent of Federal Uranium Corporation, Salt Lake City. He will supervise milling operations at gold, silver, and lead properties held by Federal. **J. B. Haffner**, former president of Bunker Hill Company, has been named as a member of the board of directors of Federal.

L. J. Scipioni has been appointed assistant superintendent of the King-Walker Mines for Oliver Iron Mining Division's Canisteo district. He was formerly general pit foreman at the Arcturus mine for the Division and at the time of his new appointment held the post of district industrial engineer.

A. Y. BETHUNE (left) is the new manager of metallurgy for The Bunker Hill Company, Kellogg, Idaho. He is in charge of the reduction plants, lead smelter and zinc plant, and 3,000-ton concentrator. His former position as zinc plant superintendent is being filled by WALTER SCHMITTROTH (right) who was assistant superintendent. SAMUEL KELLER, operating superintendent in charge of the sulphuric acid plant, is the new assistant zinc plant superintendent. DOUGLAS BAKER, research metallurgist, has replaced Mr. Keller.

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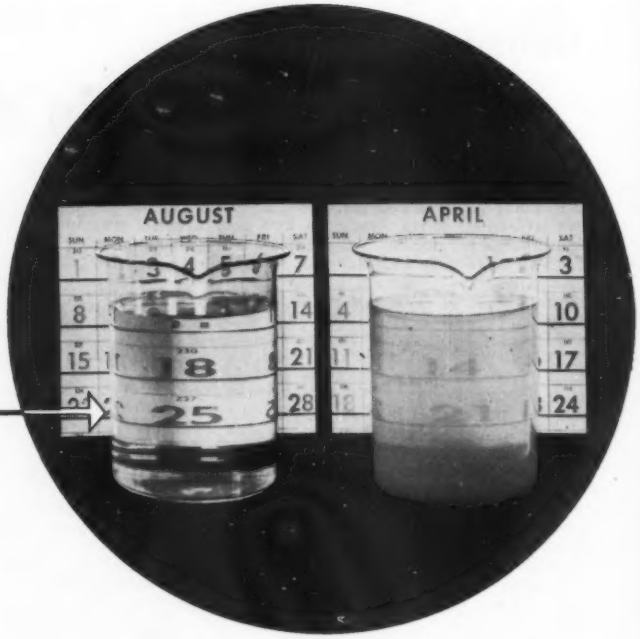

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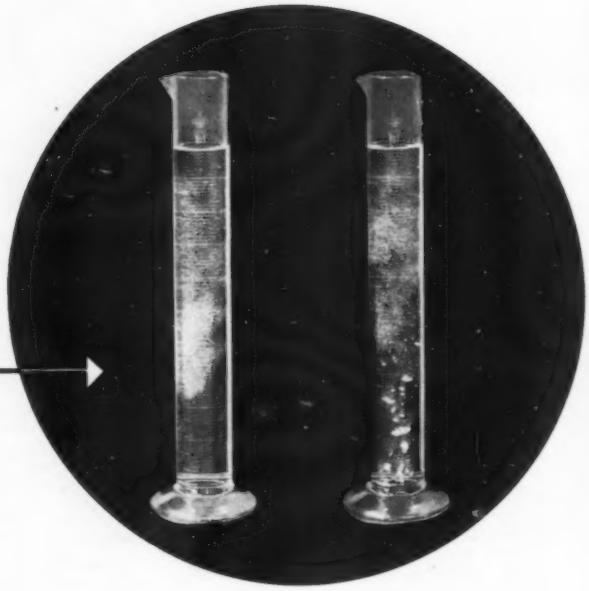

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Newsmakers in International Mining

William F. Keyes, an engineer for the United States Bureau of Mines, is now working with the Agricultural and Industrial Development Bank of Cuba (BANFAIC), under an agreement between the Bank and Point Four officials.

Lloyd Rollog has been named president of the newly organized Ketchikan Claim Holders Association. The main purpose of the association is to aid in the development of mineral areas in the Ketchikan district. An immediate aim of the association is to investigate the feasibility of constructing a smelter or reduction plant in the area or using a British Columbia plant.

James E. Atkinson has been engaged as general superintendent of the Sipalay copper project of Marinduque Iron Mines Agents, Inc, at Sipalay, Negros Occidental, The Philippines. Mr. Atkinson was formerly associated with Benguet Consolidated Mining Company and the Marsman organizations.

Dr. Neil Campbell has been appointed to the newly created position of senior geologist, special projects, for The Consolidated Mining and Smelting Company of Canada Limited. Dr. Campbell, who will be engaged in geological studies of a research character, has been district geologist for the Eastern and North Central Districts since 1951. Before joining Cominco in 1937 he was with the Geological Survey of Canada. **James Richardson** is the new senior geologist for western exploration and **Dr. P. H. Sevensma** is senior geologist for eastern exploration.

G. W. Hills has left the Electrolytic Refining and Smelting Company, Ltd, in Australia, to take over the newly created post of chief engineer for Consolidated Zinc Pty. Ltd. He will be stationed at Melbourne and will be chiefly concerned with new projects of the company.

Ralph Pray has been named to replace **Art Glover** as assayer at the Ketchikan office of the Territorial Department of Mines in Alaska. Mr. Glover recently left Alaska after 17 years with the Department. Mr. Pray had his own commercial assay laboratory at Socorro, New Mexico for several years and recently sold out. **Willow Burand** will fill the vacancy at the Nome assay office of the Department. He recently spent three years as a mining engineer at the Haystack Mountain Development Company uranium mine near Prewitt, New Mexico.

R. H. MacWilliam has been appointed a manager of Union Corporation Ltd. in London. **E. Fraenkel** has retired from the position of executive director of the corporation but remains a director.

Hugh P. Nicholson has resigned from his post as instructor in mining at the Texas Western College, El Paso, Texas, and is now in Europe.

Eugene B. Hotchkiss is president of the newly formed Bolivex Corporation, in Bolivia. It is jointly owned by Ventures Limited of Canada and Vitro Minerals Corporation of America. Mr. Hotchkiss is from Vitro. **Dr. J. D. Bateman**, of Ventures, has been named chairman of the board. **James M. Birkbeck** is the new company's vice president and general manager; **William H. Denne, Jr.** is vice president and secretary; and **Paul W. Zeckhausen** is treasurer.

EDWARD D. TIERNEY has been named general superintendent of the Great Falls Reduction Department of The Anaconda Company. He succeeds the late CLARENCE V. SAYLOR. Mr. Tierney has been general superintendent of plants for the Chile Exploration Company at Chuquicamata, Chile, and has also been associated with the Andes Copper Mining Company at Potrerillos.

R. R. Willock has accepted the position of manager of Stewarts and Lloyds Minerals Ltd., at Melton Mowbray, Leics, England.

Clarence A. Weekley, long time Philippine Islands metallurgist, has retired and is taking a trip around the world. He and Mrs. Weekley are planning to live in central Mexico. While in the Islands he was employed for many years by the Marsman interests. At the time of his retirement he was chief metallurgist for A. Soriano y Cia, and designed and supervised construction of the crushing plant and copper flotation mill for Atlas Consolidated Mining and Development Corporation at Toledo, Cebu.

Robert M. Haldeman, general manager of Braden Copper Company, a subsidiary of Kennecott Copper Corporation, has been appointed vice president. Mr. Haldeman is chief executive of the Chile company with offices in Santiago.

J. B. Richardson, formerly with the Institution of Mining and Metallurgy in London, has been chosen as Australian Representative of the Combined Development Agency as well as the United Kingdom Atomic Energy Authority. His headquarters are at Sydney.

Robert A. Cockburn has been transferred by Newmont Mining Corporation to the position of office manager for Dawn Mining company, a subsidiary in Spokane, Washington. He has been employed by Newmont about 20 years, the last 10 in Africa as secretary of O'Okiep Copper Company.

Kenji Kawai of the Mitsui Metal Mining Company, Japan, heads a team of seven Japanese mining experts who will stay three years in Bolivia to extend technical assistance to the country. It is the first time that Japan has sent technical assistance to a foreign nation for the development of nonferrous metal resources.

Cam Jenkins has joined the staff of Copper Refineries Pty Limited, at Townsville in Queensland, Australia. He will be replaced as assistant refinery superintendent at Mufulira Copper Mines Ltd., Northern Rhodesia, by **Dick Neller.**

Col. R. L. Broad has resigned as chairman of New Union Goldfields Ltd. and Merchants' Industrial Corporation Ltd. and associated companies, but will remain a member of the London Committees. His successor as chairman is **M. E. Rich.**

I. L. Barker, general superintendent of the smelting & refining department of the Cerro de Pasco Corporation at La Oroya, Peru, has been transferred to the New York offices of the Company.

Dave Young is the new mine superintendent of Mufulira Copper Mines Ltd., in Northern Rhodesia. Mr. Young was employed by Mufulira in 1950 as ventilation engineer, a year later became mine engineer, and in 1955 was named underground manager.

C. D. Clarke has been appointed assistant to the manager of operations—mining, for the Cerro de Pasco Corporation (Delaware), and will make his headquarters at La Oroya, Peru. He became associated with Cerro de Pasco's Peruvian operations in 1950. **R. M. Humphreys** will succeed Mr. Clarke as superintendent of the corporation's Cerro de Pasco mine in the central Peruvian Andes. He also joined the company in 1950 and was superintendent of the Morococha mine prior to his new appointment.

Henry Stucke, mine captain for DeBeers Consolidated Diamond Mines in the Union of South Africa, recently visited at United States mining operations of the Potash Company of America.

Ira O. N. Swanson retired recently as eastern district general superintendent of the Oliver Iron Mining Division of United States Steel Corporation.

J. O. Fifer, former vice president and director of operations at Caltex (Philippines) Inc., has been chosen managing director of Australian Oil Refining Pty. Limited to replace **M. H. Lipp**, who will remain at the headquarters in Sydney for several months in a consulting capacity before returning to the United States.

JAMES V. THOMPSON has joined Kaiser Engineers, in Oakland, California, as mining engineer-development. His responsibility will be to service industry on Kaiser Engineers mineral projects throughout the world. He also will work on the development of new projects involving consultation, studies, and design engineering in this field. Mr. Thompson's experience includes exploration and development work in the mining and milling operations of the Baguio Gold Company, The Philippines, and recently he was associated with the Humphreys Investment Company of Denver.

PRODUCTION EQUIPMENT PREVIEW

PEP is just what new equipment, increased mechanization, and new methods can give to your mine, mill or smelter. This PEP section is MINING WORLD'S way of making available to you some of the finest current information on mechanization.

Resisto-Loy Hardsurfacing Increases Crusher Wear

The new roll crusher shell shown above has been hardsurfaced with properly spaced Resisto-Loy beads and offers the user large savings in maintenance costs. The life of gyratory liners, crusher rolls, and other equipment subject to severe abrasive use can be greatly extended and maintenance costs reduced materially by use of Resisto-Loy.

Worn parts can be rebuilt back to straight with Mangatone nickel-manganese filler rod through use of the Two-Tone welding process. The Two-Tone process, which deposits greater thicknesses of metal and more pounds per hour than any other method of welding, can easily prove the answer to your rebuilding problems. Both Resisto-Loy and Mangatone are available in the U. S. through the Resisto-Loy Co., Inc. and Robert Marr & Son, Inc., export representative for users outside the U. S. For interesting and informative literature on Resisto-Loy and Mangatone, circle No. 63.

Controlled Dumping With New Ejection Trailer

The Athey Products Corporation has developed a new hydraulic ejection trailer which has wide application in mining. The new unit provides positive controlled dumping, easy ejection of adhesive material and controlled "partial load" dumping into hoppers and crushers.

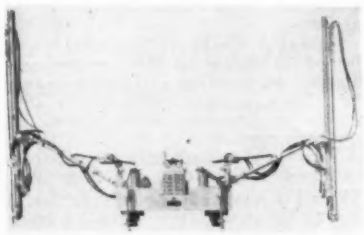
Built to handle 31 tons and powered with a Caterpillar DW21 tractor the unit has large capacity and is simple in operation. An important feature of the unit is that when dumping, the trailer does not run over the load, thus reducing tire wear and giving the material a chance to flow freely into place.

One-lever hydraulic control allows the operator to discharge the load with ease. 90 degree maneuverability and low center of gravity provide for exceptional stability and fast operation according to the company. The ejection force, up to 200,000 pounds, is developed by two-stage double acting cylinders. Tractor mounted hydraulic pump powers the cylinders. Circle No. 69 for further information.

Kennedy-Van Saun Opens New Research Laboratory

Fred O. Reedy, president, Kennedy-Van Saun Manufacturing & Engineering Corporation of New York City and Danville, Pennsylvania, announced the opening of a comprehensive research and development laboratory, serving not only the company itself, but also its industrial customers throughout the world. The new facilities, comprising an already operating Test Pilot Plant and a completely equipped chemical laboratory now being completed, are located in the company's manufacturing plant at Danville.

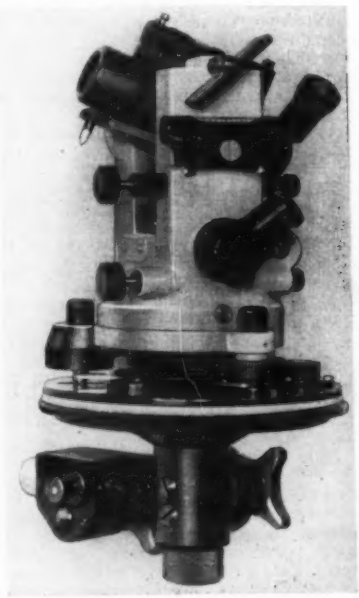
According to the company, studies and analysis ranging from single tests to long-range research will be made available to all companies, large and small on a basis of actual costs, which will be kept as low as possible. In the KVS Test Pilot Plant applied research will be carried on in the fields of crushing, grinding, calcining and related operations. The research lab is equipped and staffed to perform chemical analysis and physical testing on silicates, metals, ores, and all raw materials, as well as finished products. Full scale chemical and geological investigations will be undertaken, as well as lab foundry control. Work will also be carried on with such materials as asbestos, aluminum, and many other metals and nonmetallics. Florian Schwarzkopf, Kennedy chemical engineer is in charge of the operation.



Self-Propelled Drill Rig built by Le Roi-Cleveland

A self-propelled dual drill rig with one of the most variable drilling patterns yet attained is now being marketed by the Le Roi Division, Westinghouse Air Brake Co. Available with heavy feeds and two sizes of drifter drills, the rig is designed for fast drill speeds in hard formations, and easy maneuverability over rough terrain.

The model T286 drill may be purchased with one or two Le Roi air feeds mounted on a crawler tractor powered with a 28 hp gasoline or Diesel engine. Two seven-foot arms, mounted on swivel heads, allow an arcing of the arms which provides a drilling pattern with a 24-foot spread. The radius of turn of each arm is 220° from the mounting posts, eliminating tractor positioning after drilling each set of holes. Up and down positioning of the drills is done by an air motor. Ample lubrication is assured with the use of new two-gallon line oilers, requiring only once-a-day servicing. Circle No. 67 for additional information.



New German Theodolite Available for Mines

Geo-Optic Co. of New York, distributor for Askania Werke AG, of West Germany, has now available a new rugged mining theodolite intended for underground use. Adaptable for severe work conditions, the Tkg-A weighs only 3¾ pounds, and may be used on a tripod, set-up bar, or bracket mounting. A long diagonal eyepiece makes it possible to sight on extremely steep angles, and to plumb roof points. The compact instrument is protected against water, dust, and mechanical damage by a metal hood. For open-pit surveying, the Tkg-B theodolite with straight view eyepiece may be used. Circle No. 68 for additional information on this instrument.

UPPER 3 CARDS ENABLE

BETTER BLASTING is the title of a newsletter by Atlas Powder Co. which discusses the latest blasting methods and equipment. For your copy, circle No. 1.

LOW-COST SLUSHER HAULAGE: Joy two and three drum slushers offer many cost cutting features. The clutches are bigger and wider for longer life and are 100 percent self-energizing for easier operation. The large drum diameters give you longer life from your rope. There is only one grease fitting per drum for quick and easy maintenance. The complete line of slushers, available with 10 to 75 hp. air or electric motors, is fully described in a recent bulletin by Joy Manufacturing Co. Circle No. 2 for your copy.

INTERESTING THEODOLITE BOOKLET: Wild Instruments, Inc. offers an interesting booklet describing the Wild T-2 Universal Theodolite. The Wild T-2 features direct reading to 1 second on both circles and rapid optical plummet centering. You will want a copy of this booklet. Circle No. 3.

CABLE TOOL CATALOG: Churn drill operators will want a copy of Spang & Co.'s catalog of blast hole bits. Information on fishing tools, pilot bits for drilling large diameter holes, and other cable tools is included. Circle No. 4 for your copy of the Spang catalog.

NO OVER-HEATING PROBLEMS with air cooled Diesel engines. Deutz air cooled Diesel engines are fast starting and feature top running capacity at temperatures ranging from —40 to 140 degrees F. Deutz Diesels are available from Diesel Energy Corp., in sizes from 5 to 310 BHP. Descriptive literature is available, so circle No. 5.

CONICAL SCRUBBER CATALOG: A completely revised edition of the Hardinge Conical Scrubber catalog has just been published. The new catalog contains a complete description of the Hardinge Scrubber with ratings and dimensions, as well as approximate capacities in operation. For your copy, circle No. 6.

TWO GRADES T-C BITS AVAILABLE: Rock bits with a choice of two grades of tungsten carbide—hard for abrasive formations and medium for harder formations—are available from Joy Manufacturing Co. Other important features of the Joy rock bits include deep slotted chipways to allow cuttings to escape readily and an improved technique for brazing inserts to prevent loss and assure maximum drill footage. A free bulletin describing the entire line of Joy rock bits is available to interested mining men. Circle No. 8.

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FORCE-FEED CRUSHING ACTION: McLanahan Jawmaster Crushers feature large eccentric throws, resulting in force-feed action. The fixed and movable jaws are of extra length, providing a highly efficient narrow angle of nip. An illustrated bulletin describing the Jawmaster Crushers is available from McLanahan & Stone Corp. Circle No. 7.

RUBBERLINED SAND PUMPS with both impeller and casing rubber lined is now available for you. Working on slurries of 100 per cent minus ¼-inch material, the large capacity pumps work up to heads of 80 feet. Called "lightning" Model RU pumps, they are manufactured by the Kansas City Hay Press Co. Once the pump is assembled, and clearances set, no further efficiency adjustments need be made. Only three wearing parts are contained, and the pump features a water seal which eliminates abrasive material finding its way into the stuffing box, with resultant destruction of the shaft and packing. A stainless steel shaft adds to the long life of the unit. Circle No. 10 for further information and catalog.

DIAMOND BITS: Varel Diamond Products Co. have recently issued a new catalog covering their line of diamond coring bits ranging in size from miniature laboratory bits up through the complete mining standard ranges and the plus four-inch range for fluid and air operation. The brochure also has an interesting picture story on the steps involved in the manufacture of a bit. Circle No. 11 for your copy.

DRILL SCOUT: The Drill Scout, a small rotary drilling rig is now available to the industry from the Gustafson Manufacturing Company. The unit may be used either with rotary bits, or coring bits. Primarily used for exploration and sampling, the lightweight unit may be mounted either in a jeep or on its own trailer. According to the manufacturer the Drill Scout weighs less than 1,000 pounds, and is capable of drilling to depths of 200 feet. Circle No. 12 for brochure and additional information.

AERIAL PROSPECTING: Pick Laboratories of Saratoga, California have developed a new radiation detection unit called the Pick-Air Prospector. This detection unit is an integrated system for high-speed, high altitude radio-active mineral locating. Designed for one-man operation, no flight adjustments are required and anomaly recognition is greatly simplified. Circle No. 13 for complete brochure and complete information.

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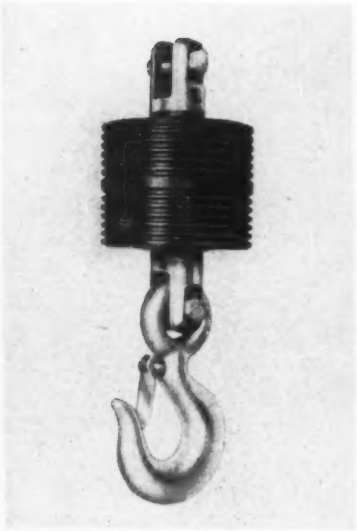
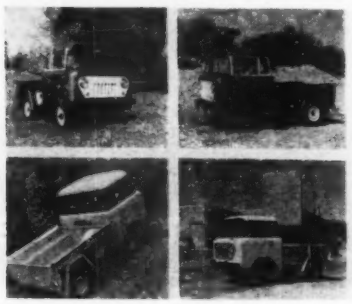


New Crane Hook Prevents Overhead Wire Accidents

General Machine and Welding Works, Inc. have developed a new insulating link which eliminates the number one cause of electrocutions in crane accidents. The new Miller insulating links replace standard crane end connections with insulated connections capable of withstanding 100,000 volts. Crane booms or load lines accidentally coming in contact with hot overhead wires can no longer cause death or serious injury. Every link is tested by a private lab to insure its insulating qualities of at least 100,000 volts. Various sizes are available. Circle No. 66 for further information.

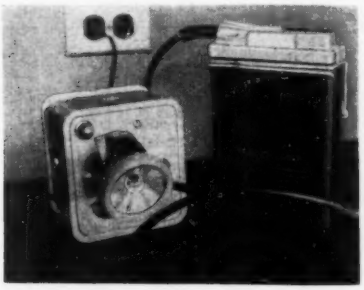


A New Type Jeep Being Introduced by Willys

A new four-wheel drive truck, the "Forward Control Jeep FC-150, is being introduced by Willys Motors, Inc. as an addition to the company's expanding line of four-wheel drive Jeep utility vehicles.

The new FC-150 incorporates new features to provide a vehicle with maximum cargo space in relation to wheelbase. The up-front location of the cab, situated well forward of the engine, allows maximum usage of the vehicle's compact 81-inch wheelbase for payloads, and places the driver in the optimum position for all-direction visibility and vehicle control.

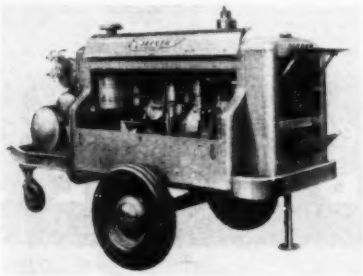
The FC-150 supplements the regular 1957 line of Jeeps, Jeep trucks, and utility wagons. Powered by the Willys F-head "Hurricane" engine, the new vehicle is engineered with four-wheel drive for off-the-road service over all types of terrain. For normal highway operation, the vehicle easily shifts into conventional two-wheel drive. Circle No. 79 for additional information.



Automatic Single-Cap Lamp Charger for Wheat Lamps

A new Wheat Automatic Single-Lamp Charger for Wheat Electric Cap Lamps has been introduced by National Mine Service Company. The problem of when to take a lamp off charge no longer need be a consideration, since the charging current of this unit automatically is reduced to a very low rate when it becomes fully charged.

The new Wheat Single-Lamp Charger is equipped with a pilot light which is on when the battery is on charge and unlighted when the battery is fully charged. Even when fully charged, the lamp may be left connected to the charger for hours or a day or two without harmful effect or excessive loss of water. When the lamp is in daily service, it may be left on charge all the time it is not in use. The unit may be plugged into any outlet having 115 to 120 volts, 60 cycle current. Circle No. 65 for the full story.



Lightweight Wheel-Mount Compressors to 250 CFM

The Jaeger Machine Company have incorporated weight saving designs in their line of compressors making possible either Diesel or gasoline engine powered rotary air compressors, as large as 250 cfm capacity, mounted on easily trailed two-wheel trucks. No valves, pistons, or crankshafts are used, and air is delivered at much cooler temperatures. A more advanced design of compressor unit enables this "Roto Air Plus" to produce full rated volume at 100 to 250 rpm slower operating speed, than many other compressors, with proportionate reductions in fuel consumption, and engine and compressor wear. Smaller 125 cfm units are also available, as well as the larger four-wheel mounted 365 and 600 cfm units. Circle No. 75 for additional data.

Notes From The Manufacturers

William T. Ahlborg has been appointed executive vice president and general manager of Denver Equipment Company. Mr. Ahlborg joined Denver Equipment in 1938 and was vice president and secretary before his recent appointment. F. J. Griesemer, formerly in charge of DECO manufacturing facilities, is the new assistant general manager. Douglas E. Newton, general sales manager, will assume additional responsibilities in administration of the company's international manufacturing and sales organization.

Douglas W. Vernon is the new sales manager for wire rope and aircord at John A. Roebling's Sons Corporation. Mr. Vernon was formerly vice president and general manager of the Leschen Wire Rope Division of the Watson Stillman Company. His office is at Roebling's main plant in Trenton, New Jersey.

E. R. Bailey has retired as manager of the San Francisco plant of the Bemis Bro. Bag Company after 52 years of service to the company. Mr. Bailey joined Bemis' Boston office as a clerk in 1904 and was transferred to San Francisco in 1906. In 1909 he opened the first Bemis sales office in Salt Lake City, and was subsequently in charge of the Denver Sales Office, and was first sales manager of the Omaha Sales Division. In 1920 Mr. Bailey became manager of the Memphis plant and in 1931 was transferred to California as manager of the San Francisco plant.

John W. Crandall has been chosen district manager of the Nordberg Manufacturing Company's territory headquarters in Duluth, Minnesota. He was previously in charge of the north central territory for the mining, crushing and process machinery division, with headquarters in Milwaukee. Mr. Crandall's new territory includes northern Wisconsin and four other states. Prior to his Milwaukee position, he was sales and service engineer in California and the northwest states for Nordberg.

Mario L. Peña, who has been in the sales department of the Compania Mexicana de Explosivos, S.A. for several years, has been transferred to the company's factory at Dinamita where he will be engaged in production work. Oscar H. Chávez, who was formerly assistant manager of the plant of Cia. Mexicana de Mecha para Minas, S.A., in Dinamita, Dgo., will replace Mr. Peña as sales representative. His territory will include the Federal District, Yucatán, Quintana Roo, Campeche, Tabasco, and Chiapas, in the export market. Mr. Chávez is a graduate in mining engineering from Texas College of Mines and Metallurgy. Prior to his employment with Mecha para Minas, he had extensive experience in mining operations of Colorado, New Mexico, and Mexico.

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Geological Survey Notes Achievements of 1956

The United States Geological Survey celebrated its 78th anniversary on March 3, 1957 by noting that the Survey's previous achievement records in mapping were topped in fiscal year 1956 by publication of some 3,019 new or reprinted topographic, geologic, and special maps —a considerable increase over the past year.

Production in fiscal 1956 swelled to more than 18,000 the number of different maps now available in the national topographic map series. Approximately 3,300,000 maps and map indexes were distributed during the year. Distribution of about 275,000 book reports and pamphlets was an increase of 62,000 copies over the preceding year—the greatest annual volume distributed by Geological Survey to date.

Mallinckrodt Chemical Works has organized a subsidiary, *Mallinckrodt Metals Company*, which will recover columbium, tantalum, and other rare metals from euxenite concentrates for commercial use. Mallinckrodt is currently extracting columbium-tantalum pentoxide and uranium from euxenite [$(Y,Ca,Ce,U,Th)(Cb,Ta,Ti)_2O_6$] under subcontract from Porter Bros. Corporation in Idaho. The columbium-tantalum goes to the GAS for stockpiling and the uranium to the AEC. Neither columbium or tantalum is sold commercially by the firm at present.

Drilling operations are planned for a uranium prospect in southeastern Caddo County, Oklahoma, near the town of Cement. Leases are held by the *Lister Brothers* of Chickasha, Oklahoma. A 13-ton shipment was made last summer to AEC buying station at Grants, New Mexico. This assayed 2.66 percent uranium oxide. Ore ranged from a few inches to four feet below the surface, and occurred as a carnotite stringer or in yellow lumps.

The *Lead Industries Association* will hold its 1957 annual meeting at the Drake Hotel in Chicago, Illinois on April 24 and 25. The *American Zinc Institute, Inc.* will hold its 39th annual meeting there on April 25 and 26. A joint meeting of the two groups on April 25 will present a discussion of the market outlook, world production, and world consumption for lead and zinc.

Mercedes Exploration Company is reported to have purchased all of the outstanding stock of *Old Dominion Manganese Company, Inc.* which owns a high-grade manganese mine near Strasburg, Virginia. Some shipments had been made under the United States government stockpiling program. The new owners plan to mine from underground workings rather than open pit which had been the previous source. The mill is to be operated at its full 300-ton capacity.

American Potash & Chemical Corporation will construct a $5,000,000 chemical manufacturing plant at Aberdeen, Mississippi for production of sodium chlorate. Initial production of the plant will be at a rate of 15,000 tons of sodium chlorate annually. Completion is scheduled for mid-1958.

Heavy Minerals Company, a subsidiary of *Crane Company* and *Vitro Corporation of America*, has been prospecting for heavy minerals and rare earths in parts of Benton, Carroll, and Henderson counties, Tennessee for the past several months. The firm is just completing a $3,000,000 processing plant at Chattanooga.

Benjamin H. Putnam has received a $57,490 DMEA loan to prospect for zinc in Grainger County, Tennessee. The government's share in the project is $28,745.

The $40,000,000 association of *Allied Chemical & Dye Corporation* and *Kennecott Copper Corporation* will be known as *Allied-Kennecott Titanium Corporation* (see MINING WORLD, February 1957, page 84.) The new firm will produce titanium chloride, titanium sponge, and titanium billets. Operations are scheduled to start late in 1958. Several locations are being considered as a site for the new plant.

New Jersey Lead and Zinc Company is reported to have started drilling on the *Elmer Vinyard* tract located in Section 15, T. 11, R. 8, which is south of Karbers, Hardin County, Illinois. The company has been leasing acreage in Hardin County for the past few years and has started a drilling program for fluorspar, lead, zinc, or other minerals.

National Research Corporation and *Columbia-Southern Chemical Corporation* have become equal partners in *N.R.C. Metals Corporation*, formerly a wholly owned subsidiary of National Research. The firm will produce and sell zirconium and hafnium metals to the AEC and other customers. Now under construction near Pensacola, Florida is a plant for production of zirconium and hafnium; schedule calls for completion by the end of 1957. The plant will be the nation's first fully integrated facility for the production of the high-purity metals available in sponge form for melters and fabricators. The zircon sand to be treated will come from Florida's beach sands. The company has a purchase agreement with the AEC for 3,500,000 pounds of zirconium and hafnium metals and will supply other industries when the new operation reaches capacity production.

The *Central Appalachian Section* of the *AIME* will meet at Maple Shade Inn in Pulaski, Virginia on May 24 and 25. The first day will be devoted to technical papers with the morning session a joint meeting between the fuels and non-fuels interests. In the afternoon these two groups will have separate technical sessions. The following day will be devoted to a field trip through the Austinville mine and concentrating plant of *The New Jersey Zinc Company*.

Hycon Aerial Surveys Inc. of Pasadena, California has opened an office in New York City at 250 Park Avenue. Dr. John Whitaker, geologist, will be eastern representative. A steady increase in all types of aerial survey work has been responsible for the expansion. Both photogrammetric services and all types of geophysical exploration work with the Varian magnetometer are showing strong activity, say company officials.

New Jersey Zinc Company's mine at Austinville, Virginia celebrated its 200th anniversary last year, marking completion of the mine's second century of continuous operation. The zinc deposit was discovered in 1756 by Col. Chiswell. New Jersey Zinc has owned and operated the mine since 1902. For the past several years a major mine development and modernization program has been underway which will extend the life of the property for many more years.

Cleveland-Cliffs Iron Company has opened a new mine called the *Sally*, which is adjacent to the *Danube*. Stripping began on January 1st. Ore will be mined this season and trucked to the *Canisteo* mine near Coleraine, Minnesota.

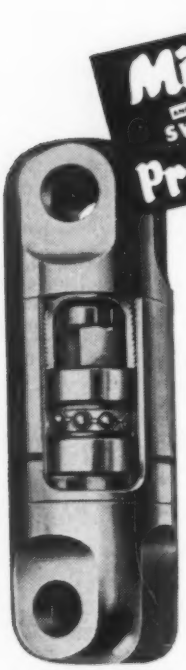
Jones & Laughlin Steel Corporation's Minnesota Ore Division has its flotation plant at the *Hill Annex* mine more than three-quarters completed. Work has also begun on assembling of the suction dredge for mining the tailings. At Gilbert, Minnesota, J&L has been stripping its *Schley* open-pit iron mine all winter.

The cyclone plant addition being erected by *M. A. Hanna Company* at the *Hunner* mine is almost finished.

The *Meadow* iron mine located north of Aurora, Minnesota, will be reactivated by *Pacific Isle Mining Company*. At present, stripping operations are in progress and a crushing and screening plant will be erected. All concentration of this ore will be accomplished at the *Coons-Pacific* concentrator at Eveleth, Minnesota.

North Range Mining Company will process 100,000 tons of lean ore from the *Fortune Lake* mine of *Pickands Mather & Co.* This ore will be processed at the *Book* mine concentrator near Crystal Falls, Michigan during the 1957 season.

Cleveland-Cliffs Iron Company has asked its stock holders to authorize the company to guarantee up to $25,000,000 future indebtedness of partnership companies if the management deems it necessary. No specific cases are contemplated, according to company officials, but the firm's officers consider it advisable to have this authority in order to take advantage of any opportunities that may arise. *Humboldt Mining Company*, jointly owned by CCI and *Ford Motor Company*, produced 200,000 tons of upgraded iron ore concentrate last year and an expansion of capacity to 600,000 tons annually is reportedly contemplated. Construction of a pelletizing plant similar to *Eagle Mills* is also said to be under consideration. The company also owns a part of *Marquette Iron Mining Company* which began producing high-grade pelletized ore last year. Capacity is now 600,000 tons a year, and it is expected that this will be doubled in the next few years.



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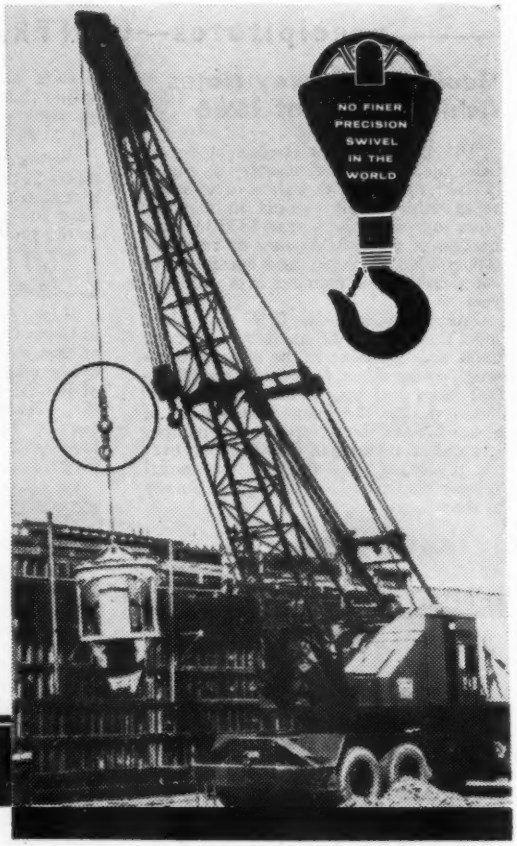

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Kennecott To Spend $18,000,000 in Utah

An additional $18,000,000 will be spent by Kennecott Copper Corporation to improve facilities and operations under the jurisdiction of its Utah Copper Division. Most of this amount, $16,000,000, will be for expansion of the company's central power station at Magna, Utah. Actual work at the power plant starts this fall, with the entire project to be completed within 2½ to three years.

A new 75,000-kw. generator will boost the power plant's output to 175,000 kilowatts. Present facilities include two 25,000-kw and one 50,000-kw. generator. Also to be installed here is a new boiler, electrical switch equipment, cooling towers, and a 20-foot extension to the present building.

Other major expenditures approved in the immediate future include: $742,500 to raise the tailing pond dike at the mills; $245,000 for new cradles for the Magna mill car dumper; $84,809 in supplemental funds in connection with laying new trackage and electrification of the Carr Fork A Level and D dump line connection at the mine. Funds will be spent also for office equipment at all properties, automotive equipment, conversion of mine wrecking crane, self propelled multiple tie tamper, ventilating facilities at the mines boiler shop, and other equipment.

The $18,000,000 approved is in addition to $12,000,000 to be spent within the next two years for a new ore haulage tunnel from the bottom of the Bingham Canyon pit to the Copperton assembly yards at the mouth of the Canyon.

The tunnel is being driven at a rate of 10 to 27 feet a day, depending upon the ground conditions. Machines involved in the process include a "big jumbo" which drills about 57 six to eight foot holes in the front of the tunnel for blasting, and an earth loader which loads the dirt onto a conveyor belt. The belt moves the dirt to rail cars which haul it to the tunnel entrance for use as fill for a roadbed between the tunnel portal and Copperton yards.

The tunnel is now a considerable distance below the bottom of the mine, but pit expansion is expected to have the mine bottom at least on the tunnel level by the time the tunnel is completed.

During 1956, *Idarado Mining Company* milled 481,700 tons of ore, compared with 274,550 tons in 1955. The ore was milled in the two mills of the company and averaged 0.067 ounce gold, 1.66 ounces silver per ton, 1.71 percent lead, 0.64 percent copper, and 2.79 percent zinc. By the end of the year, one of the mills, the Red Mountain, was closed down and production diverted to the newer and larger Pandora mill at Telluride which had been completely rehabilitated.

Two mining companies are reported to have produced about 60 percent of Boulder County, Colorado's total 1956 tungsten output valued at nearly $1,350,000. These are the *Cold Spring Mining Company* which operates the *Cold Spring* mine and mill two miles northeast of Nederland, and the *Shiprock Uranium Company* which operates the *Good Friday* and *April Fool* mines and two mills in the Sugarloaf district. At the Cold Spring, the bulk of the year's production came from the 410A ore body which was located by diamond drilling from the third level in the No. 1 shaft; the balance came from pillar salvage and fills from old stopes. The mill treated 4,300 tons of various grades of ore, to produce 270,000 pounds of concentrate. Plans are being made for construction of a tailings upgrading plant to be in operation by mid-summer. Shiprock produced 5,750 units: 5,500 units averaged 58.72 percent WO_3 250 units averaged 15.9 percent WO_3. A new 50-ton mill has been completed with magnetic separation to upgrade the ore by removing impurities. Enlargement of the second gravity-type mill at the portal of the Good Friday tunnel increased the capacity to 30 tons.

Bear Creek Mining Company, wholly owned subsidiary of *Kennecott Copper Corporation*, has named its new 1,080-foot exploration shaft in the Eureka lead-silver-zinc district of Utah for the late William A. Burgin. Mr. Burgin had been regional exploration chief for Bear Creek at Denver when he was killed in a plane crash a year and a half ago. The Burgin shaft is being sunk for Bear Creek by *Centennial Development Company*. It will have two-compartments, and should be completed this summer.

New Park Mining Company will explore the properties of *Great Western Mines Company* in the Park City mining district of Utah under an agreement recently negotiated by the two firms. Affected are about 43 claims covering 700 acres; New Park had previously staked about 300 acres in the same area. Reportedly a 1½-mile-long dike containing gold-copper-lead-silver ore will be prospected by shaft and exploratory tunnel.

Atlas Uranium Corporation, through its affiliate—*Bleak Uranium Company*, is exploring the *Piccolo Pete* claims in White Canyon, Utah under a $73,603 DMEA contract. The government's share of this contract is $55,202. Work called for included 26,353 feet of drilling. Drill depths will vary from 230 to 775 feet, with all holes going through the Chinle formation. A camp is already located on the property, and a mine access road is under construction.

St. Regis Uranium Corporation of Denver and Paradox, Colorado has leased the *Squaw Park No. 1* mine and adjoining claims in Utah to *Sandy Sterns & Associates* of Grand Junction. The lessees plan further development work and additional exploratory drilling.

Intermountain Chemical Company's soda ash plant near Rock Springs, Wyoming reportedly will be expanded from 350,000 tons to 400,000-ton capacity in 1957. Intermountain is controlled by

100,000,000 Tons of Ore Mined at Climax

The 100,000,000th ton of molybdenum ore mined at the Climax Molybdenum Company's operations at Climax, Colorado emerges from the Phillipson Level in a train pulled by a 27-ton locomotive in the photograph above. Development of the mine was started in 1918. A crushing plant was built, a Leschen tramway a mile long was installed, and a 200-ton flotation mill was erected. Today, the flotation mill treats 34,000 tons daily, illustrating the tremendous progress made by the firm over the last 39 years. Most recent concentration by management has been on increasing tonnage and recovery of molybdenum. The No. 10 ball mill entered the circuit last fall to bring the tonnage to its present rate, and the No. 17 ball mill was started the same day that the 100,000,000th ton of ore was delivered to the surface. Ball mill No. 10 was designed to increase plant tonnage by about 3,800 tons, and No. 17 will increase recovery of molybdenum disulphide concentrate by three to five percent with no increase in tonnage. Climax is the largest underground mine in North America.

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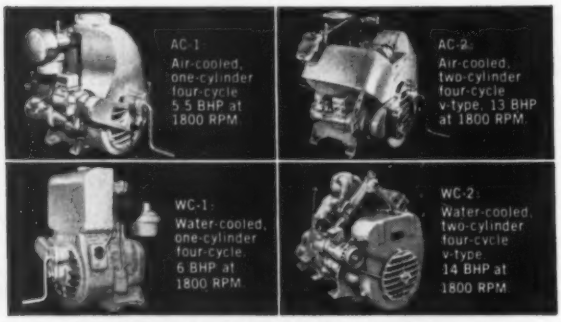

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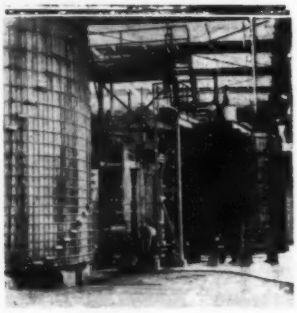

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Food Machinery & Chemical Company. A third shaft was recently completed to the trona beds in the district, and increased output from the mines because of this shaft is largely responsible for the plans to expand plant production.

A $48,460 DMEA contract has been awarded to *Antelope Mines* for uranium exploration in Fremont County, Wyoming. Government's share in the contract is $36,345.

Lost Creek Oil & Uranium Corporation, of Rawlings, Wyoming, which is constructing a uranium processing mill at Split Rock, Wyoming, has purchased the remaining 50 percent interest in the 22 *Lamac* and *Frazer* claims in the nearby Gas Hills from *Great Northern Uranium.* Purchase price was undisclosed. Lost Creek confirmed 180,000 tons of uranium ore last summer in an extensive drilling program, for which it had received a 50 percent interest. Two sides of the ore body remained to be defined when drilling shut down for the winter. Robert Adams, president of Lost Creek, said the ore will probably not be mined until 1958, then delivered to the company's mill, some 25 miles to the south.

Nearly one-third complete is construction of the *Lost Creek Oil & Uranium Corporation* uranium processing mill at Split Rock, Wyoming in the Sweetwater Valley near Crooks Gap. Art Edson, superintendent of construction for *Western-Knapp Engineering Co.* of San Francisco, contractor for the $4,750,000, 450-ton-per-day mill, said unseasonably warm weather during February expedited the work. The mill is slated to be completed by June 1. The nearby town being built by Lost Creek for mill workers has been named Jeffrey City, in honor of Dr. C. W. Jeffrey, pioneer Rawlins, Wyoming physician, who has been a leading backer of Lost Creek. It will have a population of 500 when the mill reaches full production.

A 50-ton test shipment of uranium ore has been made by *Continental Uranium* to the Riverton, Wyoming buying station from the *Gaddis* claims in the Crooks Gap area. Results have not been learned. Continental, which operates the famed *Rattlesnake* open-pit mine in Utah, has an option on the claims for $3,225,000 from *Gaddis Mining Co.* of Denver and Grand Junction, Colorado.

Lucky Mc Uranium Corporation will start large stripping operations this month on two ore bodies in the Gas Hills district of central Wyoming. More than 1,500,000 cubic yards of overburden will be stripped, but mining will not start until 1958 when the *Lucky Mc-Utah Construction Company* 750-ton-per-day processing mill is slated for completion. One pit will be 40 feet deep, the other 80 feet. The operation will also involve pumping of considerable water.

Primary ore, pitchblende, has been identified in a pilot load of uranium shipped from a strike near Dubois in Fremont County, Wyoming. The shipment was made by *Kaye Minerals* of Denver. Veteran assayer Charles O. Parker of Denver identified the ore. Some gummite and uraninite was also identified. Samples have assayed from 7 to 18 percent U_3O_8. The prospect has been closed for the winter since it lies at about 9,000 feet elevation.

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DUMAS, TEXAS

Wah Chang Mining Corporation is conducting exploration and development work at the *Copper King* mine near Bagdad, Arizona. The shaft has been retimbered to the 600-foot level and some crosscutting and drifting has been done. Much diamond drilling has been carried out over the past few months by a Spokane contracting firm. The Copper King has been a large-scale copper and zinc producer in the past.

The *Apache Powder Company*, Benson, Arizona, has announced its plans for installation of a $1,000,000 anhydrous ammonia production unit at its explosive manufacturing plant. Contract for the design, construction, and initial production was let to the *Girdler Company* of Louisville, Kentucky. According to R. L. Henderson, Apache's general manager, plans call for a productive capacity of 30 tons of anhydrous ammonia daily, about 75 percent of which will be used in the manufacture of explosives and 25 percent sold on the open market.

During 1956, *Empire Star Mines Company, Ltd.* milled 20,850 tons of gold ore mined from its Grass Valley properties in California. Mining operations were suspended in July as a result of a local labor union strike; the firm feels it cannot meet the wage demands with the current price of gold and recent disappointing mine developments. Underground dams are being constructed preparatory to allowing the mines to fill with water. These dams will effect a separation of the mines and will facilitate their separate unwatering if operations are resumed in the future. At Browns Valley, the company's small gold mine is being reopened by lessees under a three-year contract.

The Southern California Section of the *American Institute of Mining and Metallurgical Engineers* is making plans for its Second Reactive Metals Conference to be held in Los Angeles on May 28 and 29. Both technical sessions and displays will be held at the Ambassador Hotel. Dr. B. S. Mesick is general chairman.

Iron ore shipments from Lovelock, Nevada have been steady since October 1956. Up to the middle of January 1957 (about three months), the district had shipped 1,768 carloads. Heaviest shipments have been made by the *Dodge Construction Company* and *Mineral Materials Company*, both operating in the Buena Vista Valley area of Pershing County, Nevada. Most of the material has been destined for Japan, via the Port of Stockton, California.

A tungsten mill is being erected near Cherry Creek, Nevada by the *Gold Streak Mining and Milling Company*. The mill was purchased in California by Jim Duval, Sr. and Jim Duval, Jr. and moved to its present site. Formerly a gold and silver plant, it is being converted to handle tungsten ores from the *Gold Streak* mine in the Schellbourne district and from the *Calcite No. 5* mine in the Cherry Creek mining district. The latter property is owned by Louis Campanella. The mill will use a straight gravity process and will handle from 30 to 60 tons of ore in 24 hours, depending upon hardness of the rock.

The *Hamilton Land Company* will resume operations on the *Grand Prize* property in the Hamilton district near Ely, Nevada as soon as weather permits. The company took over development of the property last September. A new Atlas-Copco 300-cubic-foot compressor has been installed, along with a light plant and various buildings. To date the company has shipped about 120 tons of ore to the smelter at Midvale, Utah. The company also has about 40 additional claims under lease in the district.

United Western Minerals Company and its partners, *J. H. Whitney & Company, White, Weld & Company*, and *San Jacinto Petroleum Corporation*, have completed another farmout agreement. This one has been negotiated with *Superior Oil Company* of Los Angeles. Terms of the contract call for Superior to core drill 250,000 feet on the claims, or 50,000 feet in each of the sections involved. Superior will acquire a 50 percent interest in each section upon completion of its obligation. The remaining 50 percent of any ore discoveries will be divided as follows: United Western 25 percent and the three partners, 8⅓ percent each. The farmout covers five sections as follows: Sec. 32, T. 15 N. R. 9 W.; N½, SE¼, N½ SW¼ Sec. 16, T. 16 N. R. 12 W.; Sec. 2, T. 14 N. R. 11 W.; Sec. 32, T. 16 N. R. 11 W.; Sec. 36, T. 16 N. R. 12 W. All of these are New Mexico general mining leases and production will carry the standard 5 percent royalty to the state.

To mine and mill its uranium holdings in McKinley County, New Mexico, *Ranchers Exploration and Development Company* has entered into long-term agreements with the *Phillips Petroleum Company* and *Kermac Nuclear Fuels Corporation*, a subsidiary of *Kerr-McGee Oil Industries*. The property covers about 15,000 acres in the heart of the Ambrosia Lake district.

Homestake Mining Company and *Entrada Oil & Copper Company* have come to an agreement for exploration of Entrada's property in the Ambrosia Lake district of McKinley County, New Mexico. *Homestake Exploration*, a wholly owned subsidiary, will conduct 108,000 feet of exploratory drilling on 4½ sections, and Entrada will explore the remaining 4½ sections of its property. Homestake will drill in T. 14 N. R. 10 W.; the north half of Sec. 11; and all of Sections 33 and 35. In T. 14 N. R. 9 W., the operator is committed to exploration in Sections 7 and 19. Entrada retains rights to all of Sec. 29 T. 14 N. R. 10 W. In T. 14 N. R. 9 W. Entrada will explore all of Sections 5, 9, 15, and 160 acres in the north ½ of section 17 and 8. Entrada also is committed to drill a minimum of 24,000 feet of hole per section. All drilling will go through the Westwater member of Morrison. Entrada will retain a 50-50 interest in ore through the mill on sections to be explored by Homestake. Homestake Mining will take over mining operations for ore found on either the sections being worked by Homestake Exploration or Entrada. A capacity of 150 tons of ore per day has

National Potash in Production at Carlsbad

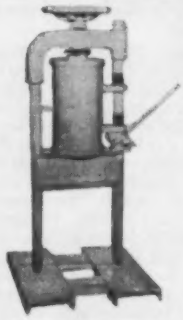
Potash shipments have started from National Potash Company's new mine and refinery at Carlsbad, New Mexico. The facilities took two years to complete and cost approximately $17,500,000. Designed capacity is 400,000 tons of high-grade muriate of potash annually. In addition to the refinery, the facilities include two 1,800-foot deep shafts (the deepest in the United States potash industry), a 21-mile water pipeline, and product storage buildings having a capacity in excess of 100,000 tons. Mining operations are highly mechanized with much of the machinery designed especially for the purpose. From left to right above are the shipping facilities, the product storage buildings, the refinery, the two headframes, and, in the foreground, the five thickeners. National Potash is owned jointly by Freeport Sulphur Company and Pittsburgh Consolidation Coal Company

been reserved at the planned Homestake-New Mexico Partners processing mill near Grants. This capacity will be turned over, however, only in the event that a minimum of 300,000 tons of ore of average grade of 0.25 percent uranium oxide is developed by either Homestake Exploration or Entrada. The north half of Sec. 11, T. 14 N. R. 10 W. already contains an estimated 100,000 tons of blocked out ore, presumably an extension of the ore body now being mined in the south half of the same section by Rio de Oro Uranium Mines, one of the participants in Homestake-New Mexico Partners.

U.S. Rare Earths and Uranium Company is considering reopening its mines in the Gallinas Mountains of central New Mexico. Robert C. Drawbaugh, manager, is reported to be in Corona, along with W. M. Heim who formerly operated rare earth properties in the district.

McKenzie and Whittle have been awarded the contract for design and construction of the shaft for *Farmers Chemical Resources Development Corporation* 30 miles notheast of Carlsbad, New Mexico. The 1,700-foot shaft is to be completed by December 1957. This will be New Mexico's seventh potash mine.

Students from a number of major universities in the United States are doing a welcome job for New Mexico in investigating geology and mineral deposition in this state. By special arrangements, candidates for Ph.D. degrees in geology or related sciences use New Mexico as a field laboratory to meet degree requirements. They work under guidance of the New Mexico Bureau of Mines and Mineral Resources, a division of New Mexico Institute of Mining & Technology, at Socorro, New Mexico.



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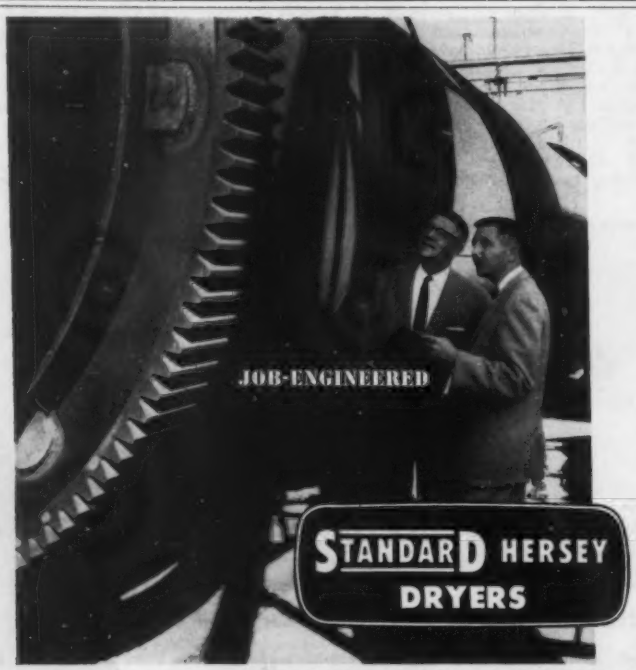
TEXAS

Texas Gulf Sulphur Company showed a decline in earnings in 1956. For the year ended December 31, 1956, the company's net profit was $28,135,880, compared with $32,356,404 in 1955. According to Fred M. Nelson, president, the decline was caused principally by a drop in export shipments and export prices, while domestic shipments were adversely affected by the steel and longshoremen's strikes. Reduced sales of fertilizers cut demand for sulphuric acid which consumes the major part of the sulphur produced. Most of the sulphur production for Texas Gulf came from *Newgulf, Moss Bluff,* and *Spindletop* deposits in Texas last year, and was the highest in the company's record. Most of it went to stockpiling. A new plant started operation in Mexico in February 1957, and another is being built at Fannett, Texas which is scheduled for production in 1958. The company is doing some exploratory drilling offshore near Galveston, where sulphur has been found. It is also drilling a sulphide ore body in New Brunswick, Canada, and is exploring in Sicily, Italy, Ethiopia, and Alaska.



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ROTARY DRYERS • CALCINERS • COOLERS • ASPHALT PAVING PLANTS

An open-pit iron ore mining operation on Iron Mountain, 35 miles north of Weiser, Idaho, is planned by *E. L. Jones and Associates* of Weiser. Immediate construction of a concentrator at the mine also was announced. Construction of a "brickette" plant to further process concentrates is planned in Weiser this summer. Long-range plans call for a $5,250,000 Weiser plant to make pig iron in an electric hydrogen furnace. Iron Mountain ore is mainly magnetite. Earl L. Jones heads the organization.

Bunker Hill Company at Kellogg, Shoshone County, has boosted capacity of its concentrator to 3,000 tons of ore daily by installation of a new grinding circuit. It has completely Dieselized its five-mile railroad through addition of two Diesel locomotives, and has installed a two-way radio system in company trucks, cars, and loaders.

A 600-foot, three-compartment, 65° inclined offset winze is being put down at the *Galena* mine west of Wallace, Shoshone County, Idaho, by *American Smelting and Refining Company*. The winze site is in the center of a silver-copper vein 1,000 feet long and up to 10 feet wide. Completion at the 4,000-foot horizon, about 1,300 feet below sea level, will make the mine one of the Coeur d'Alene mining district's deepest. Mucking is being done with a Cryderman mucker used in deepening the four-compartment main incline at ASARCO's *Page* mine. A double-drum hoist from the company's recently closed *Frisco* mine is in use. Daily mine output keeps the Galena mill operating at capacity of about 375 tons daily. J. C. Kieffer, Wallace, is manager of ASARCO's Northwest mining department.

Deepening of the main shaft at the *Lucky Friday Silver-Lead Mines Company* property east of Mullan, Shoshone County, Idaho, has progressed beyond the 2,750-foot level, where a station is being cut for a new working level. Production is continuing at about 150 tons daily. Zinc values have decreased with depth and millheads have been running about 12 percent lead and 20 ounces of silver to the ton, with less than 2 percent zinc. Charles E. Horning of Wallace is president.

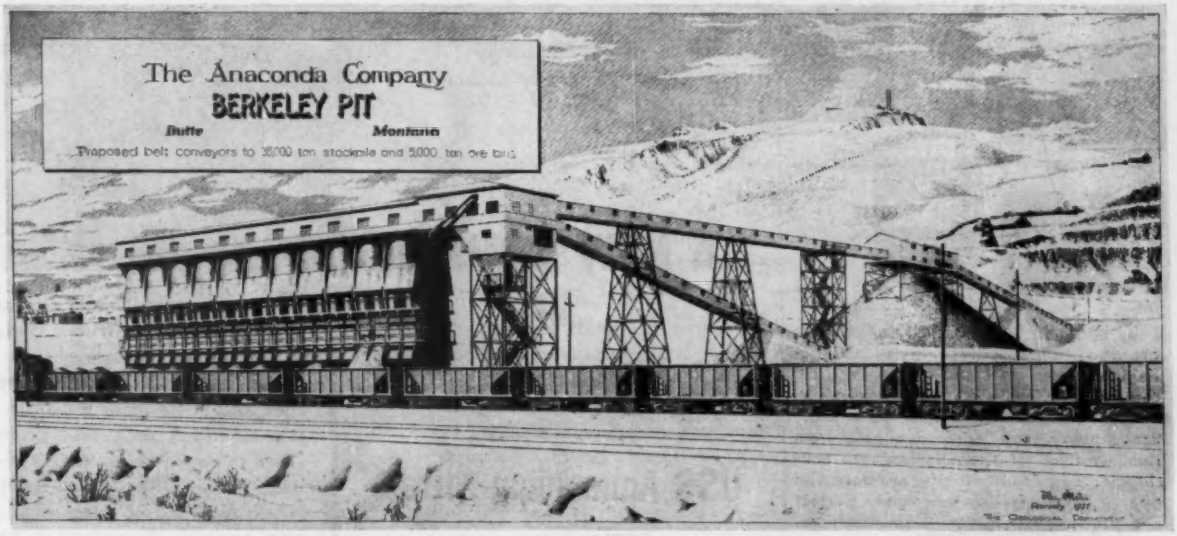
Several short zones of silver-copper ore have been opened by development work on the new 2,500-foot level in the *New Purim* area of the Silver Belt between Wallace and Kellogg, Shoshone County, Idaho, by *Polaris Mining Company* and *Silver Dollar Mining Company*. The exposures are above ore first found on the 3,000-foot level 500 feet below.

A $9,960 lead-zinc exploration project at the *Seagraves* mine, Seafoam mining district, Custer County, Idaho, has been approved by the Defense Minerals Exploration Administration. The money will be spent in diamond drilling. James Seagraves is mine foreman. V. D. Warner of Portland, Oregon, is secretary of *Seagraves Mining Company, Inc.*, an Idaho corporation.

Clayton Silver Mines is preparing to open at greater depth ore bodies in its mine near Clayton, Idaho. Instead of extending the main shaft, however, a winze will be put down near the North ore body which is yielding much improved silver values on the 550-foot level. The new winze level will be at a depth of 700 feet. Also planned is development of narrow seams of high-grade lead-silver ore on the adjoining *Ella* group of mining claims. Last year was the best in the firm's history, with smelter receipts of around $750,000, compared with about $500,000 in previous best years. Norman M. Smith is general manager.

July 15 and 16 have been selected as dates for the 54th convention of the *Idaho Mining Association* at Sun Valley, Idaho. An educational program is planned to emphasize the potential of Idaho's untapped mineral wealth, including the rare earths and other minerals in black sands which early-day placer miners termed "nuisance" minerals.

A contract signed by *Bunker Hill Company* and *J. R. Simplot Company* provides that Bunker Hill will supply Simplot with up to 5,000 tons of sulphuric acid monthly for the next 11 years. The contract also provides for certain increases in tonnage when required by Simplot because of increased fertilizer sales. The sulphuric acid plant with a designed capacity of 100,000 tons of

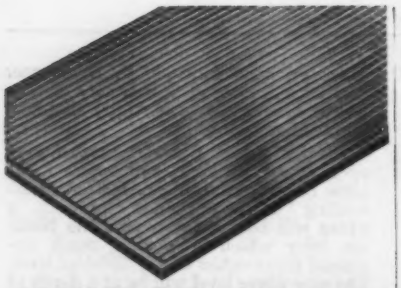


Proposed Ore Handling Installation at Anaconda's Berkeley Pit

Shown above is an artist's conception of what the proposed installation for handling ore from The Anaconda Company's Berkeley open-pit mine at Butte, Montana will look like when completed. Full production of 17,500 tons of low-grade copper ore from the Berkeley is expected to be reached by mid-year.

A concreted, belt conveyor incline, fed from one of two underground crushing sites established within the pit limits, will daylight beyond the southern perimeter of the Berkeley open pit as shown. Provision will be made at the Butte, Anaconda & Pacific railroad-loading facilities for sufficient headroom and area to accommodate a 30,000-ton surge-stockpile. The ore bins have a capacity of 5,000 tons each, and will be fed directly from the conveyor leading from the underground crusher or from the reclaiming conveyor extending below the stockpile.

Truck haulage is now employed in the Berkeley open pit with waste and overburden being transported to a dump area north of the open pit. At the present time daily production of ore (approximately 5,000 tons) is trucked to a temporary surface crushing plant on the east side of the Berkeley open pit. Two underground sites have been selected for location of permanent, coarse crushing facilities. Both are located on the projected line of the concrete-lined, incline conveyor tunnel. The upper crushing station will be located near the southern boundary of the pit and trucks will dump ore into a raise feeding the crusher. As mining progresses to lower benches, the upper crushing station will be abandoned and facilities moved to the lower crushing station which is more centrally located within the pit limits. Location of the crushers underground with feed raise holings within the pit will shorten haulage cycles, as well as provide an average level truck haul to disposal points.



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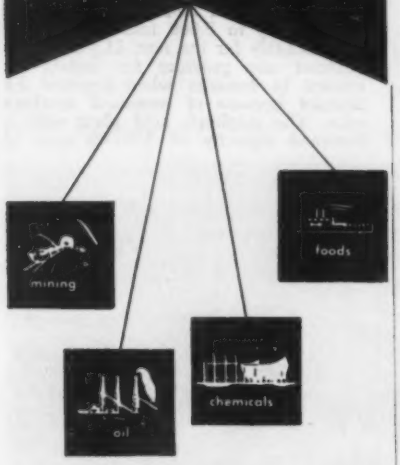

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acid per year is located at Kellogg, Idaho. Simplot's fertilizer plant is at Pocatello.

OREGON

Hanna Nickel Smelting Company's dust collecting program at Riddle, Oregon is moving along satisfactorily. The Cottrell unit on the calciners is installed and operating, and the Baghouse units which are planned for the furnaces, skip hoist, and day bins, are expected to be in operation by the middle of the year. This program will increase the amount of nickel recovery, in addition to alleviating other dust problems.

The 1957 Pacific Northwest regional conference on the AIME will be held at the Multnomah Hotel in Portland, Oregon on April 11, 12, and 13. Dr. Augustus B. Kinzel, vice president in charge of research, *Union Carbide and Carbon Corporation*, heads the list of outstanding speakers for the three-day event. He is scheduled to address the Friday night banquet on the subject of "Research in the New Metallurgy." Field trips are planned to the *Oregon Metallurgical Corporation*, the *Wah Chang Corporation*, and the *Bureau of Mines* at nearby Albany. Contact Edward A. Vistica, 304 Public Service Building, Portland, for further information.

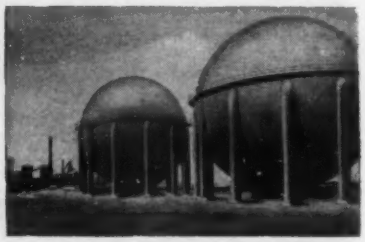
Discovery of uranium in a type of ore new to the area of Lake County, Oregon has been reported by Don Tracy. He identified the ore as uranophane, a secondary ore associated with uraninite and pitchblende. The discovery was made on claims he located on Thomas Creek in 1955. Mr. Tracy and his wife reportedly made the original discovery at the *White King* site now under lease to the *Lakeview Mining Company*.

The old *Steam Beer* mine 17 miles north of Grants Pass, Oregon reportedly has been leased by *J. P. McKee and Associates* of Vancouver, British Columbia who plan to reopen the property. A gold ore treatment plant is to be installed which will handle bulldozed ore by gravity feed.

WASHINGTON

According to the *Goat Creek Mining and Development Company* at Mazama, Washington, in the north central part of the state, the *American Smelting and Refining Company* will survey the Goat Creek district this summer. The *U.S. Forest Service* is building a road up through the middle of the district for timber, and this should aid in development of the area.

The *United Cascade Mining Company* is reported to have sold on option two properties up the middle fork of the Snoqualamie River in Washington to the



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Anaconda Company for $1,500,000. Anaconda is said to have started road construction but was stopped by the winter snows.

Dawn Mining Company, a subsidiary of *Newmont Mining Corporation*, has received a certificate of necessity for construction of its 400-ton-per-day uranium processing plant at Ford, Washington. About 80 percent of the total cost of the $3,757,000 plant will be amortized over a five-year period.

Addy Development Company of Addy, Washington, has contracted to sink an inclined shaft for *Daybreak Uranium, Inc.*, at the *Lowley* lease uraninite mine in the Spokane Indian Reservation, Stevens County. The one-compartment, 6- by 6-foot shaft will go down 50 feet on a structure from which five cars of ore were shipped in surface bulldozing. The contract includes 175 feet of drifting at the lower horizon. The company expects to obtain about 2,000 tons of development ore from the work by the time a uranium processing plant starts operations at Ford, Washington this summer. Addy Development is owned by Frank Birch, mining engineer, and George A. Monroe. Kae Sowers, Opportunity, is secretary-treasurer of Daybreak Uranium.

A. F. Bradeen, Colville, Washington, and Everett W. Stark, San Francisco, California, are extending a 200-foot tunnel at the leased *Kelly Camp* tungsten mine near Curlew Lake, Ferry County, to gain depth on a new surface showing. Bulldozing uncovered a flat-lying tungsten vein some 400 feet west of the mine shaft and sinking disclosed an underlying copper vein striking in the opposite direction.

A-1 Exploration Company, a closed corporation headed by Robert Martin, Los Angeles, California is putting down the Spokane district's first uranium exploration shaft. The work, on the *Tester-Behlau* lease in the Mount Spokane area, northern Spokane County, Washington, was down 30 feet at last report. Autunite is the ore mineral.

Highnoon Uranium Mines, Inc. expects to start ore shipments in the spring from a group of mining claims leased recently in Pend Oreille County's Lost Creek area for $25,000 plus royalties. Good showings of high-grade autunite were reported found beneath overburden. The showings are two miles from the nearest road and construction of an access road was scheduled as soon as weather permitted. The firm recently increased capitalization from 2,500,000 shares to 5,000,000. Charles A. Pulford of Newport, Washington is secretary.

Exploration beneath an iron capping is planned by Albert L. Ray of Spokane, and Clarence R. Carr of Valley, Washington at a four-claim group recorded by the pair in the Stevens County copper belt west of Waitts Lake.

Goldfield Consolidated Mining Company of San Francisco has suspended operations at its *Deep Creek* mine and Sierra Zinc mill near Aladdin, Stevens County, Washington because of inability to sell zinc concentrates. About 45 men had been employed in the mining, milling, and trucking of 800 tons of concentrates monthly. Only about half of the past year's production had been sold when the shutdown order came. Trueman (Cy) Higginbotham of Colville is manager. George Wingfield of Reno, Nevada is company president.

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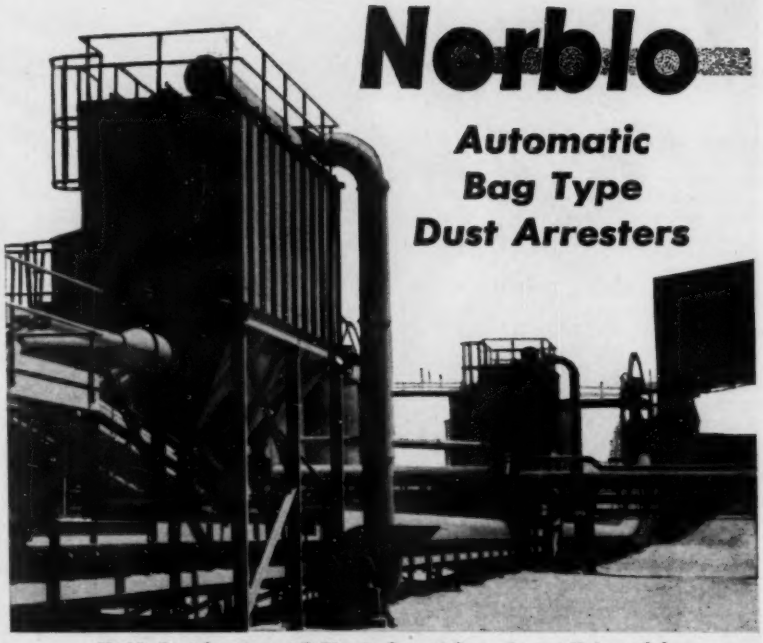

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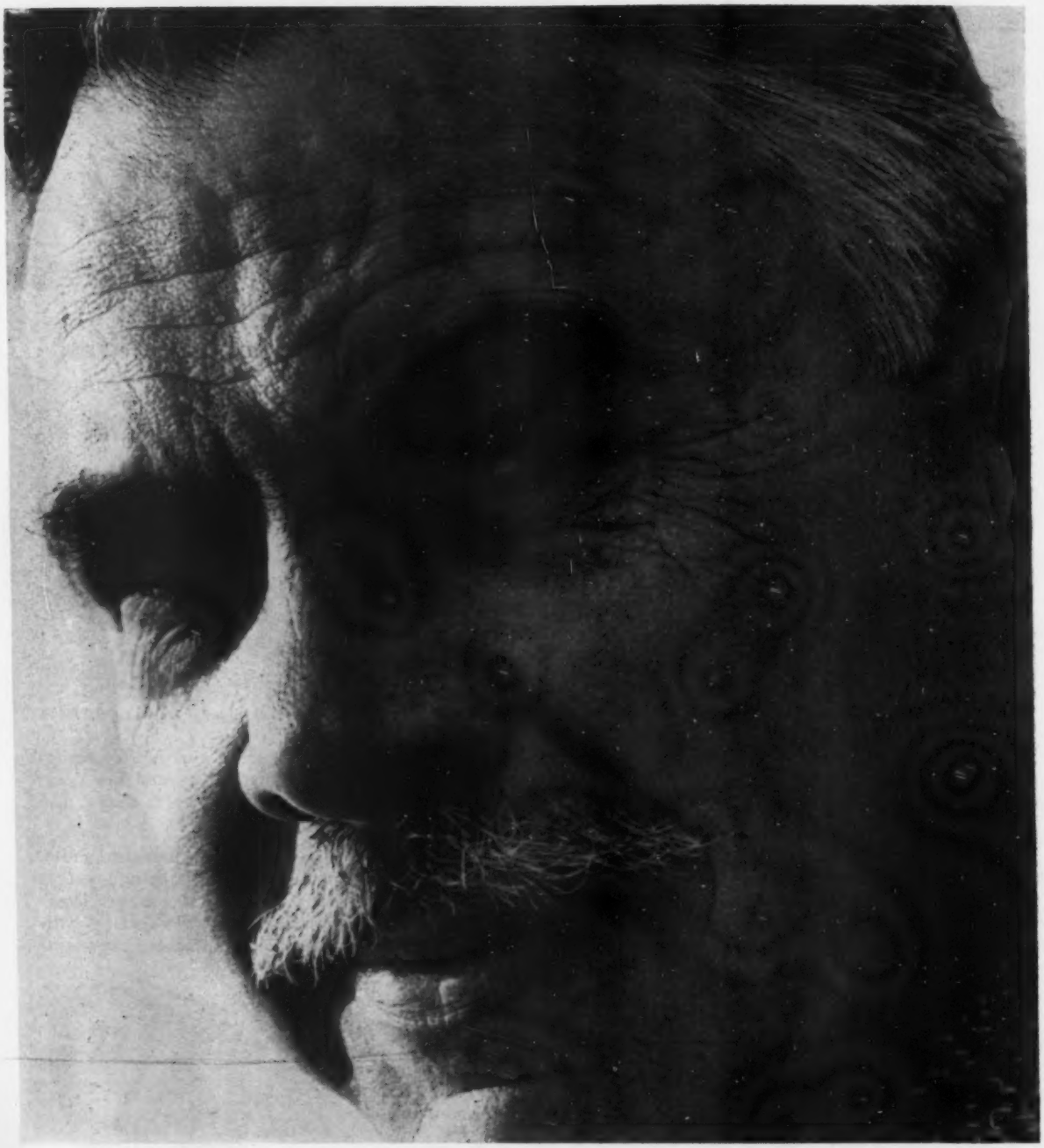

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Newmont-Rio Tinto Firm Granted African Lease

The Palabora Mining Company, Ltd., owned by Newmont Mining Corporation, Rio Tinto Company of South Africa, Ltd., and Transvaal Ore Company Ltd., has been granted a prospecting lease over an extensive deposit of copper, considered to be mainly malachite and azurite, at Phalaborwa in the northeastern part of the Transvaal, Union of South Africa.

Preliminary prospecting operations were conducted by the Department of Mines. The additional prospecting, to be undertaken by the new firm, will cost an estimated £250,000.

A statement of the Department of Mines reports that the capital cost of bringing the deposit to production will be about £25,000,000, once the prospecting program has shown that the deposit can be mined economically. The ore grade is relatively low, and operations will have to be conducted on a large scale.

The prospect area is partly on the property of the State-sponsored Phosphate Development Corporation (FOSKOR). Mining rights have not yet been granted to the new company, and the application for these may be delayed until the prospecting program has been completed.

Huge Swedish Iron Plant Opens at Kiruna Fields

Production is now underway at a new 4,600-ton-per-hour iron ore dressing plant in the Swedish Arctic ore fields at Kiruna. Under construction since 1954, at a total cost of over $10,000,000, this plant is said to be the world's largest of its type.

When it is fully completed, the plant will have eight pairs of magnetic dressing sections, each with a capacity of 500 tons per hour. The total yearly capacity will be about 13,000,000 tons. Each pair of the sorting sections is connected with a mine shaft which is fed by underground crushing stations.

Official dedication of the new plant is set for October, when the nationalized Loussavaara-Kiirunavaara Company takes over operation of the Kiruna ore fields and adjacent iron ore mines at Gallivare-Malmberget from the Grangesberg parent company.

Open-pit mining has been active at Kiruna since late last century, but by 1960 surface mining will be concluded. Plans for the future call for a large increase in output, from the 1956 high of 10,000,000 tons for the entire area to a capacity of 15,000,000 to 20,000,000 tons annually.

Canadian Charleson Plans Low-Grade Iron Mining

The newly formed firm, Canadian Charleson, Ltd. of Hibbing, Minnesota, plans to develop a low-grade iron deposit, glacial moraine, in the area of Steep Rock Lake, Ontario. The deposit is located approximately two miles northwest of Antikokan, Ontario and is adjacent to the Steep Rock property. Present plans call for treatment of 375-tons per hour containing 10-13 percent Fe with expansion to 750 tons per hour after one year of operation. Construction of the plant will commence in spring 1957 with operation scheduled for spring 1958.

The ore will be mined with tractor scrapers. Ore will be dumped at a screening plant at which all the plus-¾-inch material will be rejected as a waste representing 5 to 10 percent of the total crude. The minus-¾-inch fraction will be placed in a surge bin, before going into the rougher or primary jig section. All beneficiation will be accomplished with 5-foot by 16-foot Wemco Remer jigs. The rougher jig section consists of five Wemco Remer jigs. The tailings of these jigs will be a final tail. All rougher concentrate is sent directly to six 5-foot by 16-foot jigs. Cleaner concentrate, the final product, amounts to 37-40 tons per hour containing 57 percent Fe and 6 percent SiO_2. The cleaner jig tailings are combined with rougher tailings for further treatment and sizing for use as concrete gravel and sand. Production of sand and gravel will be dependent upon demand for these materials in the area.

The predecessor of this company was Charleson Iron Mining Company of Hibbing, Minnesota. This company had operated a jig plant near Virginia, Minnesota from 1948 through 1956. During this period they produced 1,187,812 gross tons of concentrates from the lean ore stockpiles of the old Missabe Mountain mine. All testwork on the Canadian property was performed in the Minnesota Remer jig pilot plant, during 1955 and 1956. Extensive exploration of the deposit was made in 1954, 1955, and 1956.

Officers of the organization are: C. H. Remer, originator of the present Remer Jig, president; A. T. Steele, vice president; John Maki, general superintendent; Clifford Bauers, plant superintendent; and Tyrone Murphy, master mechanic.

Hanna-Newmont Smelt Oregon Ni Ore in Mexico

The Hanna Coal and Ore Corporation and Newmont Mining Corporation have undertaken a large-scale lateritic nickel ore smelting experiment at Santa Rosalia, Lower California, Mexico. Hanna operates the United State's largest nickel mine at Riddle, Oregon and mined and shipped nickel ore last year to Mexico for the experiment.

At Santa Rosalia one of the old copper reverbatory furnaces of the Compania Minera Santa Rosalia (formerly Boleo Estudios e Inversiones Mineras S. A.) was rebuilt last year for the experiment. Smelting of lateritic nickel is not new, but the average grade of the Oregon ore (about 1.5 percent nickel) is considerably lower than the grade normally considered necessary for smelting. In New Caledonia and in Japan where New Caledonian ore is smelted, a minimum grade of 3.5 percent is desired.

New Caledonian practice calls for reduction with a gypsum and/or pyrite flux to an iron-nickel matte containing 30 to 45 percent nickel. It is then blown in converters and iron oxide slagged off to yield a 78 percent nickel matte. Japanese practice is similar. At one Japanese smelter, the second matte is roasted and reduced to crude nickel. Other Japanese companies use electric smelting as do the newer New Caledonian smelters. The crude nickel from the roaster is melted and cast into anodes for electrolytic refining, as is the converter matte.

Newmont spent $480,242 on the smelting experiment in 1956.

Philippine Plan To Free Blocked Pesos for Dollars

The Monetary Board of the Philippine Central Bank has announced a plan for converting blocked peso funds into dollars which can be remitted abroad. Foreign accounts in the Philippines have been blocked since 1949. The amount to be freed is about 60,000,000 Pesos or roughly $30,000,000.

The plan would allow holders of these funds to use them to buy domestically mined gold on the free market in the Islands at the prevailing free market price and then resell to the Central Bank at $35.00 an ounce. These dollars would then be freely transferable abroad.

As an alternate plan, the blocked pesos could be invested in production of local motion pictures for export. The foreign exchange proceeds from the sale of these films abroad would be retained by the investor.

The plan is expected to boost local gold production, especially if the Congress does not extend the existing partial subsidy to the industry. Under the present subsidy program, gold producers must sell 75 percent of their output to the Bank at Pesos 70 per ounce, plus a subsidy allowance that brings the price to about Pesos 111 for marginal producers and Pesos 105 for non-marginal producers.

ALCOA To Build Smelter In Surinam for Bauxite

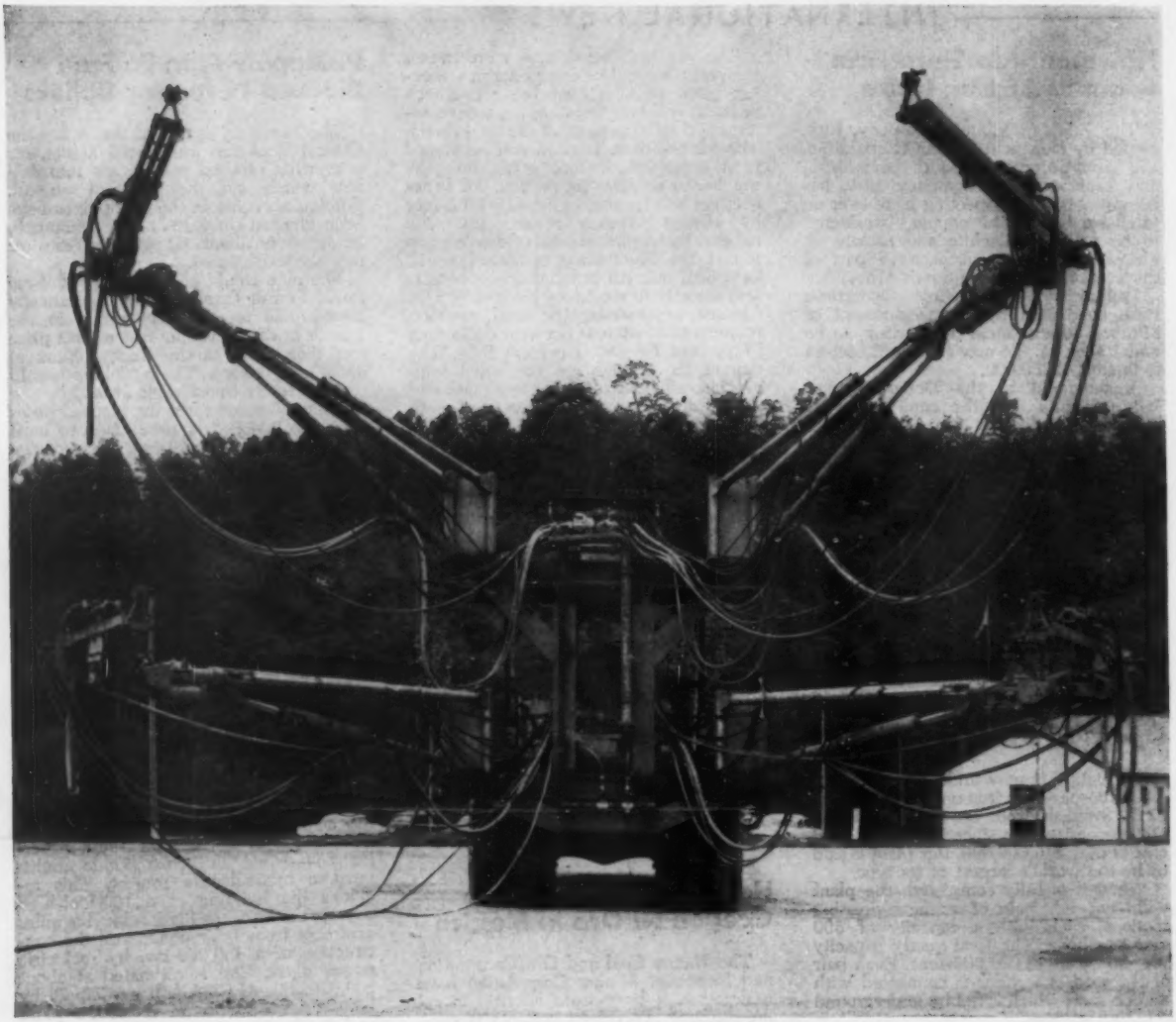
The Aluminum Company of America has signed a "letter of intent" with the government of Surinam in South America concerning the Brokopondo multipurpose hydroelectric project. This includes the building of a 160-foot-high dam on the Surinam River some five miles upstream from Brokopondo and the construction of a 150,000-kw. hydroelectric power plant. Cost is estimated at about $60,000,000. ALCOA will participate by building an aluminum reduction plant and an alumina plant near Paranam, producing about 30,000 to 40,000 tons of aluminum annually.

The government will reserve the country's whole northeastern part for ALCOA's bauxite exploration on which the company may spend some $5,000,000. Arrangements have also been made for ALCOA to form a Surinam subsidiary.

New Zinc Smelter Slated For Australian Firm

Sulphide Corporation Pty. Ltd., a subsidiary of Consolidated Zinc Pty. Ltd., will build a zinc smelter at Cockle Creek, near Newcastle, New South Wales, Australia. This, with ancilliary activities, such as sulphuric acid manufacture and increased fertilizer production, is estimated to cost more than £A8,000,000. (In recent years, £A2,000,000 has been spent on improvements and extensions to the acide and fertilizer production plant at Sulphide Corporations and the present project is in addition to this.)

The zinc smelter will use the vertical process recently developed by Imperial Smelting Corporation of Great Britain for simultaneous recovery of lead and zinc. The first unit is expected to operate within three years, and the complete project will be completed within six



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years. The plan is contingent upon satisfactory arrangements being made with the State Government for the transport of zinc concentrates from Broken Hill. Ultimate planned zinc output is 47,000 tons per year.

Consolidated Zinc is undoubtedly in the forefront of Australia's mining and metallurgical companies, with the following interests: Zinc Corporation mine at Broken Hill, 700,000 tons of ore per year containing about 70,000 to 80,000 tons of lead and 60,000 tons of zinc; 30 percent interest in New Broken Hill Consolidated N.L. in New South Wales; Imperial Smelting Corporation, England; National Smelting Company, England; Sulphide Corporation Ltd., New South Wales; Titanium and Zirconium Industries Pty. Ltd., Queensland; 50 percent interest in Broken Hill Associated Smelters Pty. Ltd, South Australia; 33⅓ interest in Anglo Australian Corporation; management of Rum Jungle uranium mine and plant; controlling interest in Yukon Consolidated Gold Dredging, Canada; and various other Canadian and British interests.

NORTH AMERICA

BRITISH COLUMBIA—Swedish financier Axel L. Wenner-Gren and associates are seeking permission from the B.C. government to develop a 40,000-square-mile concession in the north central part of the province. Mineral, timber, and hydroelectric concessions within the area are specifically sought. A British Columbian firm, *Wenner-Gren B.C. Development Company*, has already been organized and is prepared to begin $5,000,000 preliminary surveys of the area at any time. The area sought includes the location of the *Ingenika* mine.

ONTARIO—*Caland Ore Company*, a subsidiary of *Inland Steel Company*, has awarded a shaft-sinking contract to *Patrick Harrison & Company* of Noranda. Work will start immediately on the 8-compartment opening which will be sunk to an initial depth of 1,300 feet. First iron ore production will be from an open pit and this is scheduled to begin in 1960.

ALASKA—The Nome Chamber of Commerce has asked Secretary of the Interior, Fred Seaton, to explore the possibilities for increasing production of mines on the Seward Peninsula. A Chamber of Commerce report shows that until five years ago there were at least 55 placer gold operations in this area, including large dredges; today these operations do not exceed 10. High cost of labor and materials, and stabilization of the price of gold are blamed for the decline. The Chamber urges that roads be extended into the mining areas as a means of reducing production costs. The report cites as an example the Kougarak mining district where all material taken in and all gold concentrate taken out must be transported by air.

MANITOBA—Shaft sinking is making progress at the nickel-copper property of *New Manitoba Gold Mines* in the Cat Lake area. The shaft will bottom at the 500-foot horizon with three stations cut at the 175-foot, 350-foot, and 500-foot levels. Capacity will be for handling 2,000 tons through the shaft daily; however, initial production will be at a rate of 1,000 tons daily. Metallurgical test work at *Battelle Memorial Institute* is continuing and plans will be drawn for a 1,000-ton-per-day concentrating plant.

QUEBEC—The Department of Geological Sciences at *McGill University* in Montreal is offering a new two-year course leading to a degree of Master of Science (Applied) in Mineral Exploration. New discoveries and techniques in geology, mining, metallurgy, physics, and chemistry have made this desirable in order to provide adequate training for students entering the mineral exploration field.

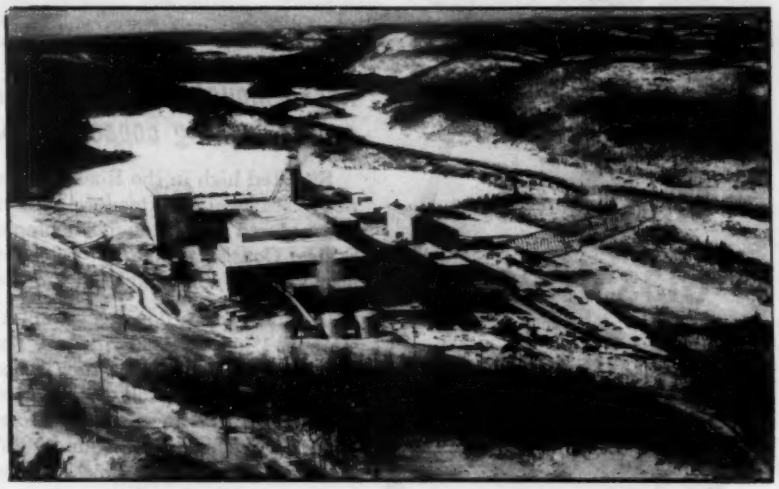
BRITISH COLUMBIA—A nickel discovery has been reported south of Atlin. The deposit has been traced for a distance of about 40 miles, with the width of the veins varying between 200 and 600 feet. Over 700 claims have been filed, with *Canadian Explorers Ltd.* holding the main discovery claims.

ONTARIO—The *International Union of Geodesy and Geophysics* will hold the XIth General Assembly of the group in Toronto September 3 through 14. The main topic will be the International Geophysical Year (IGY) to be launched in July. The IGY will be an 18-month concerted effort by more than 50 nations and 5,000 scientists, and is expected to cost over $300,000,000. From July 1957 to January 1959, experts in 14 fields of research will investigate the earth from pole to pole, from ocean floor to outer space. All over the world, simultaneous measurements will be taken on such phenomena as the aurora, cosmic rays, meteors, the upper atmosphere, glaciers, oceans, gravity, magnetism, earth tremors, solar flares, and sunspots.

BRITISH COLUMBIA—*Cassiar Asbestos Corporation Ltd.* completed its new aerial tramway between the mine and mill last year and it has resulted in more efficient and less costly transportation of the crude ore to the mill. It also provides greater reliability of transportation during bad weather. Further expansion of production is planned for this year. Larger equipment is being moved to the mine, and a long-range stripping program is to be undertaken. *Newmont Mining Corporation* owns 17.1 percent of the company.

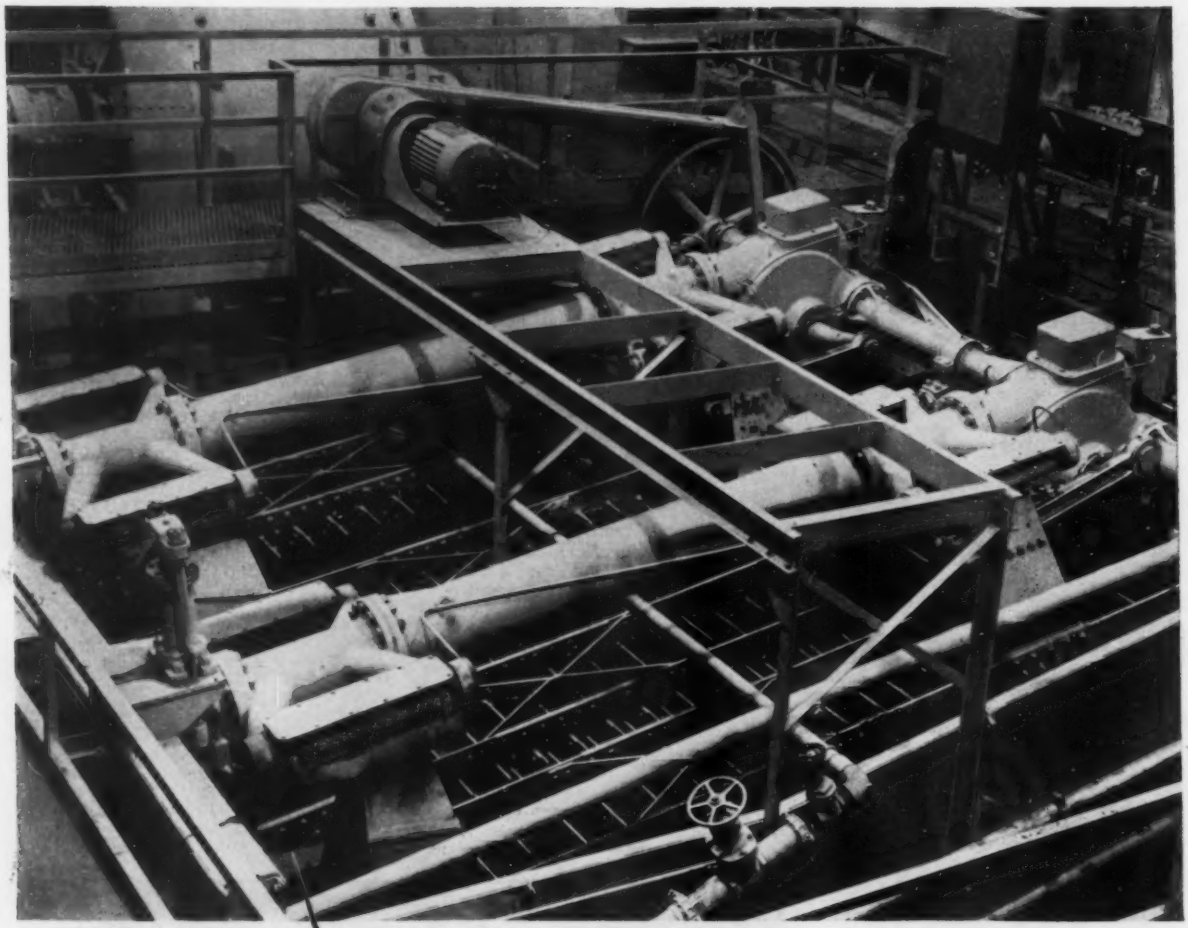
SASKATCHEWAN—*Cayzor Athabaska Mines Ltd.*, located in the Beaverlodge area, has completed first stages of the program for bringing its uranium mine to production, and shipments to the Lorado custom mill are to start this month. Cayzor has a five-year contract calling for delivery of 2,774,000 pounds of contained uranium oxide. A three-compartment shaft was sunk to a depth of 250 feet and two levels opened in the spring of 1955. Drifting and crosscutting have been continuing on these two levels. Tonnage is expected to be augmented considerably when the third and fourth levels are also opened. The shaft has already been deepened to 665 feet, with levels being stablishd at 445 and 570 feet.

MANITOBA—*Sherritt Gordon Mines Ltd.* is continuing its sinking of the Farley shaft to the 2,000-foot level. Exploratory drilling is also going on, but full-scale exploration will await completion of the shaft. During last year, the company mined and milled 750,000 tons of



Algom's Two Uranium Plants Now in Operation

Algom Uranium Mines, Ltd.'s twin plants have gone into production in the Blind River district of Ontario, Canada. Pictured above is the Nordic Lake plant which made its first shipment on January 20th. It is currently treating about 2,000 tons per day. The huge concentrator is at left in the photo, while the crusher house and main office buildings are at the right. The high tailing trestle can be seen stretching out over the valleys. In the distance (at right) is Northspan's Lake Nordic mine. The sister plant at Quirke Lake has been about six months ahead of the Nordic operation since the start of development. Both plants have a designed capacity for 3,000 tons. Reserves at Quirke Lake are estimated at 7,463,500 tons averaging 0.106 percent uranium oxide, and at Nordic 6,171,000 tons averaging 0.113 percent. Rio Tinto Mining Company of Canada controls and manages the properties. In February 1955, the company obtained a five-year purchase contract for uranium precipitates valued at $206,910,000 from the government's Eldorado Mining and Refining Company. It was reported to be the second largest awarded to any individual mining company, and the second awarded to any Eastern Canadian uranium mine.



Idarado Mining Co. Classifies Complex Ore Body with DORR heavy duty Classifier

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nickel-copper ore, compared with 762,000 tons in 1955. Ore reserves as of December 21, 1956 totaled 13,070,000 tons averaging 1.108 percent nickel and 0.58 percent copper. This is 750,000 tons less than at the end of 1955.

QUEBEC—During 1957, the *Molybdenite Corporation of Canada* hopes to conduct a research program with the Quebec government with a view to refining its bismuth concentrates. Molybdenite Corporation and the *Consolidated Mining and Smelting Company of Canada* are the only bismuth producers in Canada at present. Production for Molybdenite Corp. in 1956 totaled 1,413,400 pounds of molybdenite (MoS_2), compared with 1,288,777 pounds in 1955. Bismuth production was 117,043 pounds, compared with 98,987 in 1955.

ONTARIO—*Reef Explorations Ltd.* will drill its 25 nickel-copper claims in the Temagami district this spring. Bids have been requested for an exploration program. Surface work completed before winter snows shut down operations had revealed nickel-copper sulphide mineralization at intervals over a strike length of one mile.

NORWAY — *Sydvaranger Iron Ore Company* at Kirkenes, which celebrated its 50th anniversary last year, set an all-time production record of 1,100,000 metric tons of magnetite concentrates with 64.5 percent iron (dry weight) in 1956. The old record was 900,000 tons in 1938. The entire operation was fully described in the special October 1953 issue of MINING WORLD.

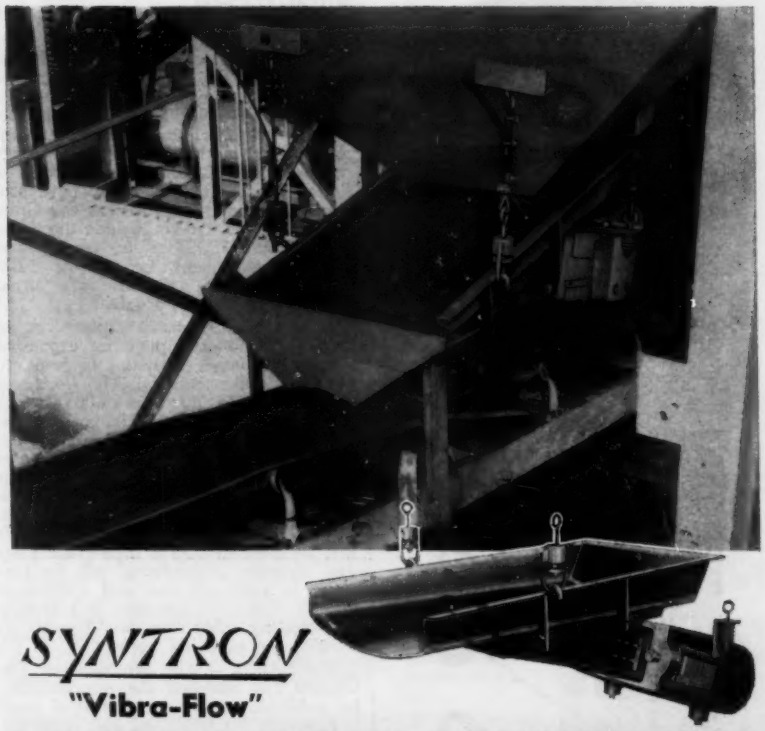
CORNWALL—At *Geevor Tin Mines*, the flotation plant used to remove sulphide minerals from the gravity concentrate has been rebuilt and is in operation. On the Atlantic Coast near Camborne, *Mineral Recovery Ltd.* which suspended operations over a year ago has now resumed treatment of beach sands containing cassiterite. The operation is at Gwithian.

WEST GERMANY—Iron ore production increased by more than 10 percent in the first month of 1957 over the preceding month. In December 1956 output totalled 1,382,194 tons; this rose to 1,528,726 tons in January 1957. Iron content of the ore increased from 363,907 tons in December to 403,183 tons in January.

BELGIUM—*Union Minière du Haut Katanga*, with operations in the Belgian Congo, has established a new company in Brussels called *Centre d'Information du Cobalt*. The company's assignment is to promote the use of cobalt in Belgium and abroad. A capital of 2,000,000 Francs has been placed at the company's disposal.

ITALY—Italy is reported to have exported 64,960 flasks of quicksilver during the first 11 months of 1956, compared with 19,198 flasks in the same period of 1955.

ISLE OF MAN—Two new companies have been formed to prospect for lead and zinc. The *British Metal Corporation* and *John Taylor and Sons* (consulting en-



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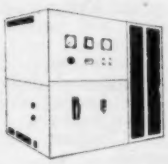
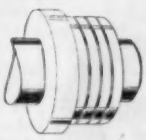


SHAFT SEALS



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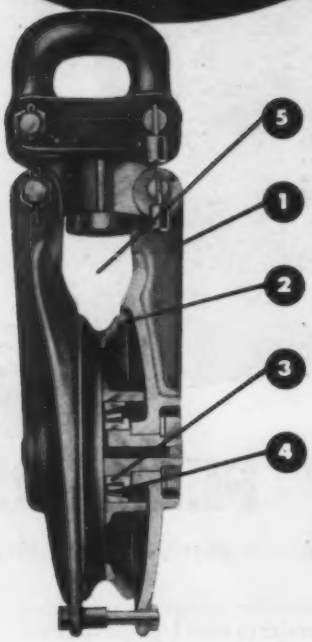

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gineers) have formed the *Island Exploration Company* with the support of local business interests. They have been granted a four-year prospecting license. The *Snaefell* lead-silver mine is to be reopened by *Metalliferous Holdings Ltd.* At one time the island was a fairly large producer and 16 mines are recorded as former producers. The last to have produced lead in the island was the *Great Laxey* in 1919. Others include the Snaefell, *Bradda*, and *Foxdale*, where some tailings have been removed for treatment. Felspathic rock is also quarried and processed near Foxdale.

NORWAY—*Christiania Spigerverk* of Oslo has announced plans for expansion of the company's activities in iron ore mining and beneficiation. The *Roedsand* mine will be expanded from 100,000 tons to about 300,000 tons of magnetite concentrates (with some vanadium) a year. Production of some ilmenite concentrates will also be undertaken this year. The electric smelter at Svelgen will increase pig iron production from 50,000 to 200,000 tons annually, and vanadium will be recovered as a high-grade slag. The ilmenite concentrates will be furnaced to yield pig iron and a titanium dioxide slag. The company is currently investigating other iron ore deposits in western and northern Norway.

ENGLAND — The *International Tin Council* has assumed the responsibility for publishing of tin statistics as of April 1. Formerly the work had been done by the *International Tin Study Group*. The Council will be located at 35, Piccadilly, London, W. 1, England.

BULGARIA — Approximately 145,000 metric tons of lead and zinc concentrates were produced in Bulgaria during 1956.

WEST GERMANY—A low-grade iron ore deposit has been proved in the Salzgitter area near Hanover. The iron content is between 20 and 30 percent, and in some cases as high as 44 percent. Depth of the deposits ranges between 600 and 1,250 meters. The *Ilsede-Peine* company reportedly plans to enlarge its plant to handle the ore from the new discovery.

ERIE—Good values in gold and antimony have been encountered by *Can-Erin Mines Ltd.* in channel sampling of the old *Clontibret* antimony mine in County Monaghan. This mine is located in the 85-square mile Castleblayney concession, one of three being developed by Can-Erin. Access was only recently gained to the Clonibret mine where limited underground development was carried out several years ago. Cleaning out of the 47-foot vertical shaft permitted entry and channel sampling of the underground workings. Satisfactory progress is also being made on the company's *Allihies* concession in west County Cork at the *Bearhaven* or *"Hungry Hill"* group of copper mines. Delivery of the surface mining plant will permit dewatering and rehabilitation of the 1,800-foot shaft at the *Mountain* mine. Three surface and two underground drills are currently being used. Another drill is operating at the *Tassen* lead-zinc mine, a few miles from Clonibret on the Castleblayney concession.

SWEDEN—The *Graengesberg Mining Company* plans to build a new steel plant at Oxeloesund which will treat iron ores from the mines at Graengesberg and from newly opened mines at Strassa. The new plant is designed for an annual capacity of about 430,000 metric tons of crude steel and some 300,000 tons of rolling mill products.

FINLAND—After two years of prospecting, a promising gold vein has been found at Sodankyla in northern Finland.

ENGLAND—*New Consolidated Goldfields* is exploring the old lead mines in the Allenhead district of Durham County and has started a crosscut near the bottom of an incline shaft in the *Swinhope* mine. The mines in this area probably date from the 16th century and worked or explored at least 11 lodes. A great deal of the high-grade ore in the area came from "flats" in the limestone associated with the lodes.

U.S.S.R.—Soviet steel production is reported to have been 48,500,000 metric tons in 1956, slightly below the 49,000,000-ton goal set for the year. During the final year of the current five-year plan, 1960, production of crude steel was expected to reach 68,300,000 tons. It is not known yet whether this figure will be changed, since the government has revised its plan in order to provide greater production of consumer goods.

POLAND—Iron and steel production in Poland last year totalled about 5,000,000 metric tons of crude steel and 3,500,000 tons of pig iron. Rolling mill production amounted to about 3,300,000 tons. Goals set for 1957 include 5,370,000 tons of crude steel, 3,750,000 tons of pig iron, and 3,540,000 tons of rolled products.

MEXICO—A new mercury mining district has been discovered at a place called Coacoyula de Alvarez, state of Guerrero, located 40 kilometers southeast of Iguala. Otto Fyre and associates are diamond drilling the *Ixtola* deposits there with apparently good results.

CUBA—*Cuba International Mining & Development Corporation* is developing a 25,000-acre nickel concession located north of Camaguey, Cuba in the mountain range known as the Sierra de Cubitas. This is a nickeliferous ore deposit of the lateric type, very similar to that at Moa Bay. Assays range from 0.4 percent nickel to 5 percent and from 0.1 percent cobalt to 1.5 percent.

ARGENTINA—The Argentine Atomic Energy Commission reports that a uranium rush has started within the country, spurred on by the recent government decree which offers awards to all prospectors for discoveries of uranium deposits. The commission reportedly made 200 Geiger counters available to prospectors, and counters can now be purchased locally in the shops. Seven uranium ore mines are said to be in production, and discoveries are being made in various parts of the country. Still unknown and unexplored are the extensive areas of Santa Cruz and Tierra del Fuego in the extreme south.

COLOMBIA—*Asnazu Gold Dredging Ltd.'s* No. 1 dredge ceased operations on November 26, 1956, bringing the firm's operations in Colombia to an end. The company will now go into liquidation and the assets will be distributed to shareholders some time during this year.

During last year, Asnazu dredged 1,176,520 cubic yards to recover 13,946 ounces of fine gold. In the previous year, the company had dredged 1,246,240 yards to recover 12,663 ounces. In 1956 *Pato Consolidated Gold Dredging Ltd.* dredged 27,553,000 cubic yards to recover 197,840 ounces of fine gold, as compared with the previous year when 26,836,000 cubic yards were dredged to recover 160,891 ounces.

BRAZIL—A private syndicate composed of United States stockholders is reported to have purchased the majority of the shares of *St. John d'el Rey Mining Company* which has been producing gold in Minas Gerais state for 126 years. Of chief interest now is the fact that there are about 2,000,000,000 tons of iron ore reserves in the property, in addition to the gold. It is said that the best hematite ore found there has iron content of 65 to 67 percent. The property also contains bauxite and manganese, as well as gold; the latter reserves are estimated at 7,000,000 tons.

MEXICO—*Explorers Alliance Ltd.* of Toronto, Canada intends to start construction of a large zinc treatment plant this summer, according to a company spokesman. The site will be either at Tampico or Saltillo, capital of Coahuilla. Plans for the plant are ready and a few details, mostly legal and administrative, are being finalized.

CUBA—The *Grande* mine near El Cobre in Oriente province produced 620 tons of copper during the last quarter of 1956. All of this was exported. In the same period, the *Matahambre* mines in Pinar del Rio produced 68,041 tons of copper ore, shipping 12,331 tons of concentrate to Carteret, New Jersey.

COLOMBIA—*South American Gold & Platinum Company's* offer to acquire all outstanding ordinary and preference shares of *Frontino Gold Mines Ltd.* in exchange for South American Gold's six percent eight-year debentures has been declared effective. South American had previously acquired 80,000 shares of the total 243,963 outstanding before it made the exchange offer. It is expected that Frontino will become a wholly owned subsidiary. Frontino owns and operates the largest underground gold mines in Colombia. It moved its headquarters from the United Kingdom in December 31, 1956 so it is no longer subject to British taxation. In 1956 it produced $3,000,000 worth of gold. South American has been producing gold and platinum in Colombia since 1917.

ARGENTINA—The government, through the IAPI, a commercial agency, will continue the purchase of certain minerals, including beryl, lead, wolframite, and mica, for the next six months as a monopoly. After this period, the national government plans to return them to free trade.

MEXICO—*Compania Minera de Penoles* has renewed operations at the *La Suriana* mine, located in the Achotla district in the municipality of Arcelia state of Guerrero. About eight years ago, the main shaft caught fire because of the combustible nature of the pyritic ore. This primary ore contains 2 grams gold, 300 grams silver, 2 percent lead; the oxidized zone assays higher grade ore—9.5 grams gold, 650 grams silver, and 4 percent lead.

BRAZIL—A deposit of uranium ore was discovered recently by Orlando Watt Longo in the vicinity of the city of Aguasdo Prata, Sao Paulo State. The ore occurs disseminated in sandstone of Triassic Age, and near the contact with nepheline rocks. Some of the chemical analyses showed a uranium content of 0.5 percent.

FEDERATION OF RHODESIA AND NYASALAND—Nickel has been discovered near Bindura, Southern Rhodesia in a deposit reportedly assaying 3.78 percent. The *Vanadium Corporation of America* is said to have taken a development option on the claims and according to C. A. Bott, general manager, the company intends to start exploration work immediately. Actual work will be done by the firm's subsidiary, *Rhodesian Vanadium Corporation.* Geological opinion, however, is sceptical about the economic value of these serpentine nickel discoveries.

FRENCH WEST AFRICA—A new company has been formed to develop bauxite deposits in Fria, French Guinea. An initial capital of 1,000,000,000 francs has been put up by two French companies—*Pechiney* and *Ugine*, as well as the United States firm of *Olin-Mathieson Chemical Corporation*, the *British Aluminium Ltd.* and the Swiss concern of *Aluminum Industrie-Aktiengesellschaft.* The new firm will be called *Cie. Internationale pour la Production d'Alumine.* A plant capable of producing 480,000 tons of alumina annually will be erected. Most of the alumina will be used by aluminum industries to be established in French Guinea and the Middle Congo.

UNION OF SOUTH AFRICA—In the 31 days of January, the *Free State Saaiplaas Gold Mining Company Ltd.* sunk its No. 1 shaft (24-foot-diameter, inside lining), 684 feet, or 17 feet more than was achieved in 1955 by the *Vaal Reefs* company in its 18-foot-diameter ventilation shaft. *West Rand Consolidated's* Monarch shaft, a rectangular unit, was sunk 763 feet late in 1955. The Free State Saaiplaas shaft is concrete lined, in which a cactus-type mechanical grab is being used. It will serve primarily as a ventilation unit. Sinking of the main hoisting shaft, No. 2, which is located about 4,000 feet down-dip from No. 1, is in its preliminary stages. Both will be sunk to 6,000 feet. The master-sinker is H. Jordaan, who was also

Construction on Schedule at Mangula Mine

Messina (Transvaal) Development Company Ltd., whose main mine is at Messina in the Transvaal, Union of South Africa (5,261,130 long tons of 1.82 percent Cu), now has more diversified interests in Southern Rhodesia. In addition to its copper holdings at Umkondo (326,990 tons of 3.39 percent Cu) and Mangula (16,000,000 tons of 1.6 percent Cu), the company has 2,190 claims of high-grade iron ore at Bukwe, and has recently acquired the old Alaska copper mine near the Mangula mine in the Sinoia area, a proved scheelite proposition on 12 blocks of claims near Bikita, and five blocks of limestone claims near Belingwe. The company is also participating in the negotiations to establish a private company to take over the state-owned Rhodesian Iron and Steel Commission. The Umkondo mine increased its output of concentrates from 1,486 in 1954/55 to 4,533 long tons in 1955/56 which are being refined at Messina. Shaft-sinking, pre-production development, and exploratory drilling continue at the Mangula mine where preliminary work in erecting the mill is well underway. The first mill'ing unit will comprise a 22-foot-diameter Aerofall primary mill and an 8-foot by 15-foot regrind ball mill, which will have a throughput capacity of 1,000 tons per 24 hours. The feed is run-of-mine ore. The mill product will be treated in a flotation plant and the concentrate in the smelter. A partial stage of construction can be seen above. At the left of the photo are the two 33-foot-diameter mill bins, with the concrete foundations for the mill substation directly in front. Behind the bins are the boiler makers' shop, the blacksmiths' shop, and the mine garage. To the right of the photo are the regind mill foundations, the flotation plant, and the 100-foot-diameter thickeners. The Aerofall mill foundation is in the center foreground, while the heavy machinery store, issuing and general stores, and construction offices and workshops are in the center background. The Messina Company holds 84 percent of the issued Mangula capital.

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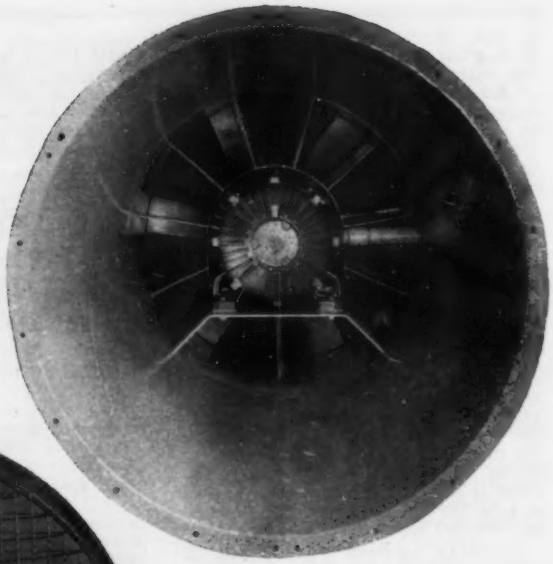

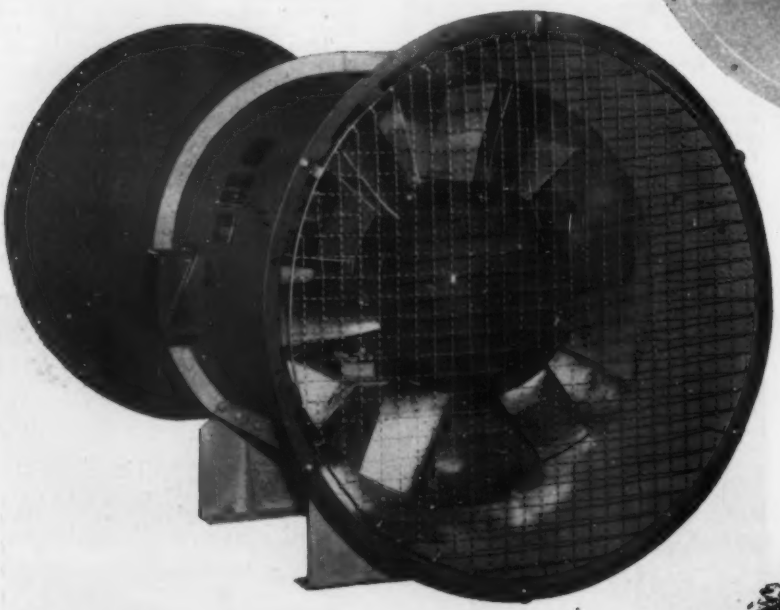

Note that a standard foot-mounted motor is usually employed in Jeffrey 6-F fans.

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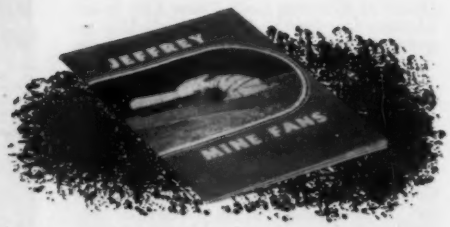

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SOUTH WEST AFRICA—Bidding is in progress for the control of the *South West Africa Company, Ltd.* which produces vanadium-lead-zinc concentrates from the *Abenab Berg* deposits in the Grootfontein district to the southeast of Tsumeb, and which owns mineral rights over an extensive area, as well as a substantial interest in *Tsumeb Corporation Ltd.* The latter is offering one Tsumeb share and 20 shillings for four South West African Company shares. The *Anglo American Corporation,* together with *Consolidated Gold Fields* and the *British South Africa Company,* is offering £5 per share for two-thirds of the South West Africa shareholding. There has been much political protest in London about the possibility of selling to Tsumeb since this would transfer control of the United Kingdom-owned company to the United States. The firm is one of Britain's chief sources of vanadium for the steel industry.

UNION OF SOUTH AFRICA—With most of the new gold mines still consolidating or advancing production, average working costs continue to be of little comparative value. For the time being, individual costs are more interesting. In the final quarter of last year, compared with the third, *Brakpan, City Deep, Grootvlei, St. Helena, Springs, Van Dyk Consolidated, Doornfontein, Hartebeestfontein, Luipaards Vlei* in its Bird Reef costs, and *Lorain* reduced their gold working costs, to which mining and milling charges are debited even though the residues are subsequently treated for uranium content. Except for *Dominion Reefs,* which is classified essentially as a uranium producer and sets all of its costs against uranium revenue, the declared uranium profits are subjected only to the costs of treatment in uranium plants. In the case of *Free State Geduld, Harmony,* and *Randfontein,* the higher working costs in the final 1956 quarter doubtless reflected increased expenditures involved in more difficult underground conditions, such as water, faulting, and/or narrow reef width. Highlights of the South African mining industry in 1956 are compared with 1955 in the chart below:

Item	*1956*	*1955*
Tons milled	67,524,700	65,950,700
Gold yield—ozs.	15,373,680	14,093,668
Gold working revenue—shillings/ton	57.25	53.83
Gold working costs—shillings/ton	42.92	40.42
Tons treated for U_3O_8 recovery	17,967,237	7,873,665[1]
Yield—lb. U_3O_8	8,449,259	3,647,112[1]
U_3O_8 per ton treated	0.47	0.463[1]
Est. working profit—gold	£48,450,407	£44,252,990
Est. working profit—U_3O_8	£24,662,054	£17,558,208
Total working profit	£73,112,461	£61,811,198
Net dividends	£28,177,343	£22,361,887
Miscellaneous output—gold—ozs.	519,255	508,599
Other output—U_3O_8—lb.	277,049	118,330[1]

1. For the second half of the year.

UGANDA—The *British Metal Corporation Ltd.* has opened a new mineral purchasing department at Kikagati. The depot was formerly run by the *British Tin Smelting Company Ltd.* but has been closed for about 10 months. Stanley Webb of the Uganda mineral buying trade has been appointed resident manager of the depot. In addition to purchasing minerals, Mr. Webb will also sell explosives.

MOROCCO—The *Ait Amar* iron mines operated in central Morocco by the *Societe Marocaine de Mines et Produits Chimiques* closed down for two weeks in February because no shipping space was available for exporting the ore to Great Britain. Lack of shipping facilities was attributed to the Suez crisis. Some 420,000 tons of ore with a 45 percent iron content were mined at Ait Amar last year, and sold mainly to Great Britain (408,521 tons) and Germany. This year market conditions were expected to be even more favorable.

FEDERATION OF RHODESIA AND NYASALAND—*Rio Tinto (Southern Rhodesia) Ltd.* has increased its pace in the exploring of the *Gatooma* deposits, and is presently sinking an exploratory shaft to 600 feet in order to obtain bulk samples for trial extraction tests. An air strip is being built and an aerial tram installed across the Umniati River to provide easier accessibility to the claims.

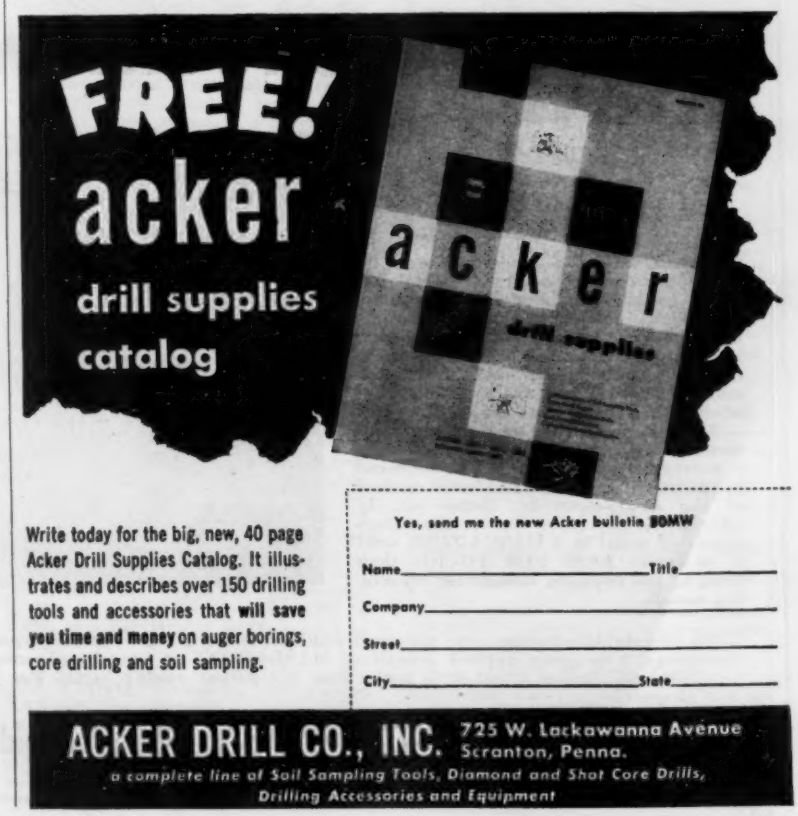
BELGIAN CONGO — During 1956 *Geomines* produced 4,007 tons of cassiterite, compared with 3,804 in the previous year, and 200 tons of tantalum-columbium as compared with 225 tons in the previous year. The latter was sold at very favorable rates under a contract concluded in 1954. New contracts have been negotiated but they are not considered to be as favorable.

TANGANYIKA—There was a marked improvement in the final quarterly returns for 1956 of the operating subsidiary of *Tanganyika Diamond and Gold Development Company Ltd.* 49,199 loads were treated for an overall recovery of 5,500.65 carats; net working profit increased to £24,821. The average quarterly results in 1956 had been 45,272 loads treated for a recovery of 3,044.6 carats, with a net working profit of £4,258. Working costs averaged £17,-217 per quarter. As the data shows, the final quarter's improvement was entirely due to higher grade ore treated.

ANGOLA—A recent governmental decree has authorized the Portuguese Minister of Overseas Territories to negotiate with the *N. V. Billiton Maatschappij* concerning rights to explore and develop bauxite deposits in Portuguese African territories. Specifically, the Billiton Company would have exclusive rights over bauxite deposits east of the 15th Meridian in Portuguese Guinea, and in Cabinda and another specified area of Angola. Billiton would have to set up a new company with a registered office and board of directors in Portuguese territories; would have to have a minimum capital of 5,000,000 escudos; maintain a Portuguese representative in Angola and Guinea; and select Portuguese nationals for the chairmanship and for one half of the positions on the board of directors.

UNION OF SOUTH AFRICA—In its first month of production, January, *Buffelsfontein Gold Mining Company Ltd.* milled 80,000 tons for a yield of 5.25 dwt. per tons. Working cost was 50.5 shillings and estimated working profit was 15.07 shillings per ton. Uranium output is scheduled from about the middle of the year.

FEDERATION OF RHODESIA AND NYASALAND—*Bancroft Mines Ltd.* has gone into partial production in Northern Rhodesia. Full capacity operation is expected by mid-year with a monthly throughput of 150,000 tons of ore yielding concentrate containing about 4,000



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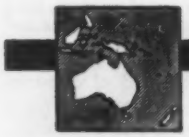
long tons of recoverable copper. Concentrate will be sent to Nkana for smelting.

FRENCH EQUATORIAL AFRICA—The managing board of the Economic Investment and Development Fund has authorized the *French Overseas Mining Bureau* to subscribe 1,100,000,000 francs toward a capital increase for *Compagnie Miniere de L'Ogoue (Comilog)*. The latter is currently developing manganese deposits in the Gabon area of French Equatorial Africa. The additional financing will increase the firm's capital to 5,000,000,000 francs. The *United States Steel Corporation* has a 49 percent interest in Comilog; the French Overseas Bureau 21 percent; *Compagnie Miniere de L'Oubangui Oriental* 15 percent; and *Mokata El Hadid* 15 percent.



NEW SOUTH WALES—Dr. John Williamson, owner of the *Williamson* diamond mine at Mwadui, Tanganyika, East Africa, will participate in a search for diamonds at Copeton, near Inverell. He will be joined in the venture by Jules Joris, a Sydney diamond merchant. The search is expected to get underway in about six months, beginning with an aerial survey. Many people who have been interested in diamond washing in the Inverell district have believed that there is a main source about 20 miles east of Copeton. New South Wales diamonds are of the industrial variety and very hard.

NORTHERN TERRITORY—*Peko Mines N.L.* recently shipped about 8,000 tons of 25 percent copper concentrate to Japan. The company is increasing the mining rate to 400 tons of ore per day, and anticipates increasing output of copper to 9,000 or 10,000 tons per year by the end of 1958 with a possible increase to 15,000 tons after that.

INDONESIA—The *Indonesian Government Mining Office* reports that tin exports, including tin metal, totaled 31,847 tons in 1956, compared with 31,963 tons in 1955. Tin-in-ore shipments in December 1956 totaled 3,365 tons, compared with 2,745 tons in November, bringing the total for the year to 31,156 in contrast to 31,765 tons in 1955.

REPUBLIC OF THE PHILIPPINES—*Philippine Base Metal Mines, Inc.* has started exploration work and development of a newly acquired manganese property in the province of Lanao, Mindanao. The property, covering more than 500 hectares, is reported to contain high-grade ore. In January, the company made its first shipment of the year to Japan from *Bueno Hills* and adjacent mining areas in Capas, Tarlac. With the encouraging results of exploration and development work in more than 400 registered mineral claims in the Capas area, all under contract to Philippine Base Metal Mines, the company will expand its operations this year by full-scale mechanization.

NEW GUINEA—For the six-month period ended November 30, 1956, *Bulolo Gold Dredging Ltd.* dredged 4,667,600 cubic yards to recover 25,936 ounces of fine gold, compared with 6,123,300 yards in the same period of 1955 to recover 15,401 ounces.

QUEENSLAND—To improve smelter efficiencies, consideration is being given by *Mount Morgan Ltd.* to installation of a fluosolids roaster in place of the Edwards roasters, and an electrostatic dust collection unit may also be built. Present production per month is 2,500 to 3,000 ounces of gold and 300 to 400 tons of copper. The firm is going through a period of low returns, and is particularly concerned about the trend of copper prices and difficulty in selling its by-product, pyrite.

VICTORIA—The state government has established a five-man advisory committee to frame a plan for base metal exploration in Victoria. This is an important development and may assist the state's declining gold industry.

REPUBLIC OF THE PHILIPPINES—*Atlas Consolidated Mining and Development Corporation* reports January production and shipping figures from its *Toledo* mine on Cebu Island and *Mati* mine on Davao, as follows: Shipments of copper concentrates from Toledo totaled 5,225 dry short tons containing 2,040,795 pounds of copper and 548 ounces of gold. In addition, 2,820 metric tons of pyrite were shipped to *National Power Corporation's* Iligan plant. Shipments of iron ore from Mati totaled 17,700 tons. Ore treated at the mill at Toledo totaled 158,790 tons averaging 0.55 percent copper and 0.01 ounces gold per ton. This lower tonnage was caused by extremely heavy

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rains during part of the month which created flood conditions at the mine, resulting in the loss of about four milling days of operation and several days of partial mill operation. Part of this loss was made up by a daily mill production in excess of 7,000 tons during the last few days of the month. The highest during that period was 7,714 tons treated.

TASMANIA—*Montana Silver Lead N.L.* at Zeehan reports that geophysical surveys and diamond drilling on its nickel-copper area indicate the possible existence of more extensive mineralization than originally anticipated. The ore channel, a basic dike, persists for two miles and is of varying widths mineralized with nickel. Operations are near the Emu Bay Railway line, about 6,000 feet from the first area drilled. Ore assaying 8.5 percent nickel and 0.13 percent cobalt has been found here. Mining on a 1,000 to 1,500-ton-per-month scale could be started now but it is believed wise to await further information.

REPUBLIC OF THE PHILIPPINES—Construction of *Benquet Exploration Company's* new 50-ton-per-day mill is making steady headway and should be in operation by July. The mill is being built on the *Thanksgiving* property of Benguet Exploration in Mountain Province and is located just off the National Highway. *Philex Mining Corporation* is managing the firm's project. To avoid damage to farmlands in the area and general pollution of the streams, all tailings and waste products from the mill will be impounded. While this is common practice in many parts of the world, this is the first time such a procedure will be followed in the Philippines.

JAPAN—A molybdenum refining plant has been completed at the Uji plant of *Kurimura Mining Company*. Monthly capacity at the installation will thus increase from 30 tons to 100 tons. There are now five molybdenum processors in Japan—*Nihon Kohan, Showa Denko, Nihon Danko, Taiyo Koko,* and Kurimura Mining. For the period from October to December 1956, total output of these five firms was averaging about 150 tons per month. Therefore, the opening of Kurimura's new plant with its increasing capacity is being watched with great interest. The short supply of Mo in Japan has sent the price extremely high in recent months.

MALAYA—The Johore government has approved an application for permission to mine iron ore in the Sungei Pilipah area, 10 miles north of Kota Tinggi. The application was filed by a group of Chinese businessmen from Batu Pahat who have formed a syndicate to develop the property. Iron ore was first discovered in the area by Japanese miners in 1931. The war interrupted any actual mining operations. Part of the area, therefore, is cleared but the rest is jungle. The ore also carries a certain amount of tin, presenting a problem of separation.

INDIA—The *National Industrial Development Corporation,* a government body, has decided to build an aluminum plant at Mettur in Madras State with a capacity of 10,000 tons per year. The *Indian Aluminum Company Ltd.* is already planning to construct a plant of similar capacity at Hirakud in Orissa state. Consideration is being given to erection of another plant in the Rihand Valley in Uttar Pradesh. All of this is in keeping with the second Five Year Plan which calls for production of 30,000 tons of aluminum annually by 1960 or 1961.

MALAYA—*Idris Hydraulic Tin Ltd.* has sold its *Kranji* section to its neighbors, *Societe des Etains de Kinta,* for £160,000. Because of this transaction, Idris' output will be low for the next 18 months or so, but the company intends to operate its mine in the *Batu Karang* section to which the power and other plants in the Kranji section will be transferred. When the deviation of the road at Batu Karang is completed, output will again be stepped up to a profitable level.

JAPAN—*Dowa Mining Company* reportedly is ready to proceed with expanded exploration and development at the *Yanahara* mine in Okayama Prefecture. Dowa found a sulphide ore deposit in the Fujiwara area last year, and since been working on plans for its development. A 600-meter shaft, equipped with a 1,100-horsepower hoist, will be sunk to the ore body which lies at 400 meters depth. When completed, 6,000 to 7,000 tons of sulphide ore is expected to be produced monthly. Reserves are estimated at 20,000,000 tons.

BURMA—An aerial mineral survey is being made of the Victoria Point area south of Mergui by a team of British experts. The project is a part of the Colombo plan for technical cooperation. These engineers, geologists, and aerial photographers will spend about four weeks in the district where some of Burma's tin mines are located.

INDIA—The production of non-ferrous metals, such as aluminum, copper, zinc, lead, tin, and antimony, rose from a value of Rupees 3 crores in 1951 to Rupees 6 crores in 1956. The import of these metals in recent years had been from Rupees 20 crores to Rupees 25 crores annually. India produces about 7,500 tons of copper from Ghatsila in Bihar out of an estimated demand of 25,000 to 30,000 tons. Work in the *Khetri* mines in Rajasthan is being intensified. If these deposits prove promising, a copper refinery of 10,000 tons per annum capacity would be planned. The *Indian Copper Corporation* at Ghatsila is also planning increased production and setting up of an electrolytic refinery for high conductivity copper. With the increased production of steel, the demand for zinc is expected to rise. Only known deposits of zinc in India are being worked by the *Metal Corporation of India Ltd.* at Zawar, Rajasthan. Mining is at a rate of 500 tons of lead-zinc ore per day; this is expected to be increased to 1,000 tons per day within the next two years. Lead production is expected to increase from 2,500 tons to 6,000 or 7,000 tons per annum in the next two years.

TURKEY—*Celik Ltd.* has been organized to develop the existing steel plant at Kirikkale. The plant will be expanded in capacity by three times its present output and will concentrate upon high grade and special steel production. *Stahlwerke Sudwestfalen* of West Germany holds 51 percent interest in the new company and *Makina ve Kimya Endustrisi Kurumu,* a Turkish state agency, holds the remaining 49 percent.

JAPAN—The *Toyo Zirconium Company,* recently established by the *Nippon Mining Company* and *Ishizuka Kenkyusho Ltd.,* has made its first shipment of zirconium sponge to the United States under a contract with the *Atomic Energy Commission.* The new firm shipped 2,280 pounds out of a total of 400,000 pounds contracted for by Ishizuka on behalf of the new firm. Delivery of the remainder is to be completed by the end of this year. Present company output is 5 to 6 tons monthly. This is to be increased to 10 tons eventually. The company is reported to be planning erection of another plant to produce 20 tons monthly.

MALAYA—1956 Malayan production of tin-in-concentrates set a postwar record with an output totalling 62,295 tons. This is reported to be 1,051 tons greater than in 1955 which had set a previous record. During 1956, production from dredging continued to decrease as gravel pump, hydraulic, and open pit mining increased. Also produced in Malaya last year were the following: gold 20,252 troy ounces; iron ore 2,444,570 tons; bauxite 264,444 tons; ilmenite 122,176 tons; monazite 631 tons; wolframite 48 tons; and columbite 277 tons.

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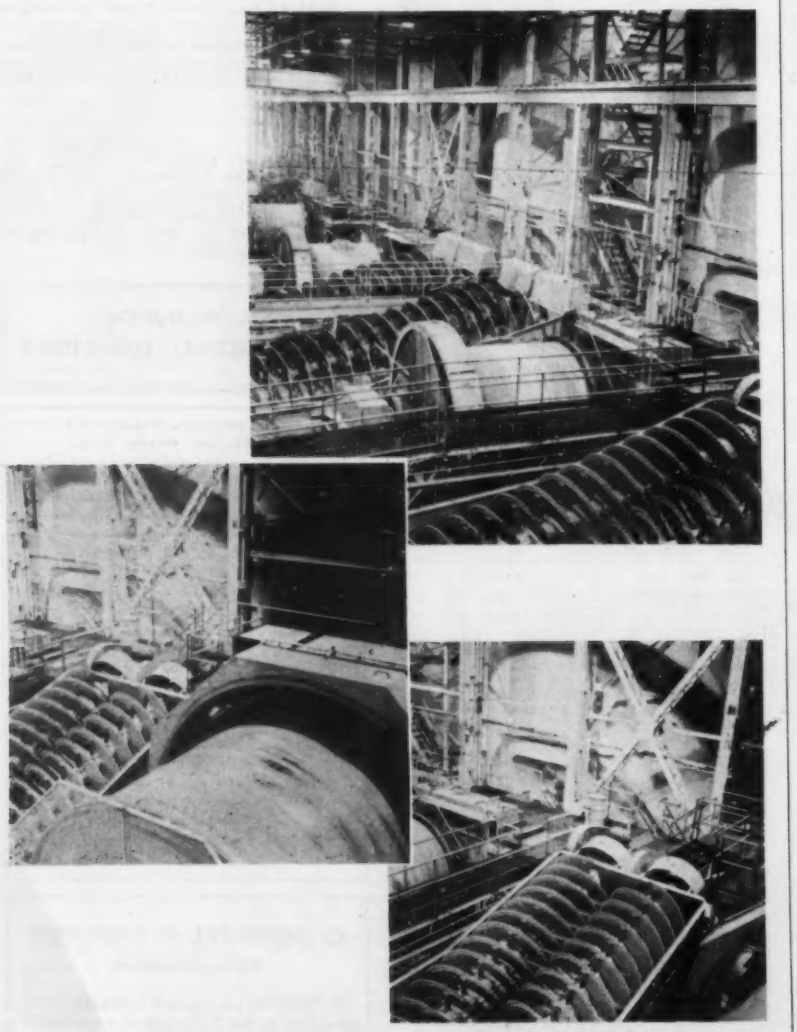

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Otanmaki

Continued from page 55 (WM35)

three shifts, the following employees are needed:

Crushing plant	*per shift*	*per day*
Shift boss	1	2
Feeder operator	1	2
Cleanup man	1	2
Total	3	
Concentrator		
General foreman		1
Maintenance foreman		1
Mechanic		1
Electrician		1
Repair gang		4
Shift boss	1	3
Mill operator	1	3
Separator operator	1	3
Flotation operator	1	3
Filter operator	1	3
Conveyor man	1	3
Helper	1	1
Swing operator	1	3
Total	8	36

Water for concentration is pumped through a 8-inch pipe line against a head of 60 meters from a river four kilometers away by an automatically controlled pumping station. Water consumption is 8.0 cubic meters per ton of ore milled. Magnetic concentration is the chief water consumer.

Tailing is laundered directly to a large swamp adjoining the mill.

Plans for the Future

The number one project in the future will be retreatment of the magnetite concentrate. Thorough tests have indicated that the present grade may not be substantially improved by wet separation, but, after drying, high grade concentrate can be obtained by a special technique. This technique is based on magnetic separation in a high-speed permanent-magnetic separator designed by Prof. Erkki Laurila[3] of Finland Institute of Technology and manufactured by Stahlbau Rheinhausen in Germany. In principal, the separator consists of a revolving wheel carrying magnets of alternating polarity and of a concentric shell revolving in the same direction at a different speed. By this arrangement a field similar to that obtained by an alternating current magnet is created and is extremely effective in breaking down magnetic flocks. At the same time, the strong centrifugal force will cause nonmagnetically freed particles to fly away from magnetic particles. Pilot plant tests have indicated that ordinary grade magnetite concentrate can be retreated to produce concentrate assaying 69 percent Fe and 2 percent TiO_2 after being dried to a moisture content of less than 0.1 percent H_2O. Full scale equipment has been operating since June.

THE END

3. Zur Theorie der Trockener Magnetischen Aufbereitung des Feinverteilten Starkmagnetischen Materials. Erkki Laurila. *Annales Academiae Scientiarum Fennicae.* Series AI 171, 26 pages (1954) Helsinki.

U.S.A. Metal & Mineral Prices

METALS

		March 15, 1957
COPPER:	**Electrolytic.** Delivered F.o.b. cars, Valley basis	32.00¢
	Lake. Delivered, destinations, U.S.A.	32.00¢
	Foreign Copper. Valley basis	32.00¢
	Custom	31.00¢
LEAD:	**Common Grade.** New York	16.00¢
	Tri-State Concentrates, lig, flotation 80% lead, per ton	$201.32
ZINC:	**Prime Western:** F.o.b. E. St. Louis	13.50¢
	Prime Western; Delivered, New York	14.00¢
	Tri-State Concentrate, 60% zinc, per ton	$84.00
ALUMINUM:	**Primary 30 Pound Ingots (99% plus).** F.o.b. shipping points	27.10¢
ANTIMONY:	**Lone Star Brand.** F.o.b. Laredo, in bulk	33.50¢
BISMUTH:	(In ton lots) price per pound	$2.25
CADMIUM:	**Sticks and bars.** 1 to 5 ton lots (Price per pound)	$1.70
COBALT:	**97.99%,** keg of 550 pounds (Price per pound)	$2.00
COLUMBIUM:	**Powder** Nom., per pound	$120.00
GERMANIUM:	**Germanium:** dioxide, high purity, gram	27.50¢
LITHIUM:	**98%** (per pound)	$11.00-$14.00
	Carbonate	82.00¢
MAGNESIUM:	**Ingots (99.8%)** F.o.b. Valasco, Texas, per pound	36.00¢
MERCURY:	**Flasks.** Small lots, New York	$255.00-$257.00
NICKEL:	**"F" Ingots (5 pounds).** F.o.b. refinery, Port Calbourne, Ontario	74.00¢
SELENIUM:	**99.5%,** per pound	$13.50-$15.50
THORIUM:	per kilogram	$43.00
TIN:	**Grade A Brands.** New York (Price per pound) Prompt delivery	$98.875
TITANIUM:	**99.3%** + Grade "A" Sponge (Price per pound)	$2.75
URANIUM:	**Nominal,** per kilogram	$40.00
U-235:	**Nominal,** per kilogram	$11,000.00
GOLD:	**United States Treasury Price**	$35.00 per ounce
SILVER:	**Newly mined domestic.** United States Treasury price	90.5¢
	Foreign Handy Harmon	91.37¢
PLATINUM:	**Per Ounce**	$92.00-$95.00
ZIRCONIUM:	**Sponge, Per Pound,** Nominal	$10.00

ORES AND CONCENTRATES

BERYLLIUM ORE:	**10 to 12% BeO.** F.o.b. mine, Colorado	$46.00 per unit
	Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at: 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $50.	
CHROME ORE:	F.o.b. railroad cars eastern seaports. Long tons dry weight.	
	African (Rhodesian). 48% Cr_2O_3. 3 to 1 Ratio	$55.00-$56.00
	African (Transvaal). 48% Cr_2O_3. No Ratio	$38.00-$39.00
	Turkish, 48% Cr_2O_3. 3 to 1 chrome-iron ratio	$58.00
	U. S. Government ore purchase depot Grants Pass, Oregon, Base price, lumpy ore, $115.00; fines and concentrates $110.00 for 48% Cr_2O_3 and a 3 to 1 chromium-iron ratio. Premiums for higher grade are and for a ratio up to 3.5 to 1. Penalties for grades down to 42% Cr_2O_3.	
COLUMBIUM-TANTALUM ORE:	At United States small lot beryl purchase depots. $3.40 per pound contained combined pentoxides in 50% ore. Includes 100% bonus. (Government stopped buying temporarily May 12)	
	Per Pound Pentoxide.	$1.15-1.35
IRON ORE:	**Lake Superior. Per gross ton Lower Lake Ports**	
	Mesabi, Non Bessemer, 51.5% Fe.	$10.85
	Mesabi, Bessemer, 51.5% Fe.	$11.00
	Old Range Non Bessemer.	$11.10
	Old Range Bessemer.	$11.25
	Swedish, Atlantic Ports. 60 to 68% Fe. Contracts, Per Unit	28.00¢
MANGANESE ORE:	**Metallurgical grade.** 48 to 50% Mn. Long ton unit	$1.60-$1.75
	Metallurgical grade. 46 to 48% Mn. Long ton unit	$1.55-$1.65
	Metallurgical grade. 44 to 46% Mn. Long ton unit	$1.45-$1.55
	Domestic U. S. Government ore purchasing depots: Butte, Montana; (black and pink ores) base price of $4.87 per long dry ton of 18% manganese ore. Phillipsburg, Montana; base price of $6.43 per long ton unit of 15% manganese ore. Small lot program f.o.b. railroad cars, minimum 40% Mn. Base price (48%) $2.30 per unit with premiums and penalties.	
MOLYBDENUM CONCENTRATE:	**90% MoS_2 F.o.b.** Climax, Colorado. Per pounds of contained molybdenum, plus cost of containers	$1.10
TUNGSTEN CONCENTRATE:	**Domestic.** 60% WO_3 Per short ton unit	$55.00
	Foreign. 65% WO_3 Per short ton unit (Scheelite)	$29.00
	Foreign. South American, Spanish, Portuguese	$22.00
URANIUM ORE:	**Carnotite-Roscoelite.** F.o.b. purchase depot plus $0.06 per ton mile ($6.00 maximum), Grand Junction, Rifle, Durango, Naturita and Uravan, Colorado. Salt Lake City, Marysvale, Thompsons, Moab, White Canyon, Green River, and Monticello, Utah. Shiprack, and Grants, New Mexico, Edgemont, S. Dakota, Riverton, Wyoming, Tuba City, and Cutter, Arizona. Base price for 0.10% ore is $1.50 per pound and up to $3.50 per pound of contained U_3O_8 plus $0.75 per pound for each pound in excess of 4 pounds per short dry ton and an extra allowance of $0.25 per pound for each in excess of 10 pounds. A $0.50 per pound development allowance paid on all ore purchases. Special lime schedule applies at Monticello, Moab and Grants. No lime penalty with no vanadium payment or lime penalty with vanadium payment.	
VANADIUM ORE:	**Carnotite-Roscoelite.** V_2O_5 in ratio of more than 10 parts to 1 part of U_3O_8 are generally acceptable at all AEC depots, but excess not paid for at Marysvale, Monticello, and Bluewater. Shiprock has no limit on V_2O_5 to U_3O_8 ratio and all contained V_2O_5 is paid for	Per Pound V_2O_5 $0.31

NON-METALLIC MINERALS

BENTONITE:	**Minus-200-mesh.** F.o.b. Wyoming points. Per ton in carload lots	$12.50
	Oil Well grade. Packed in 100 pound paper bags	$14.00
FLUORSPAR:	**Metallurgical grade.** 70% efective CaF_2 content per short ton F.o.b. Illinois-Kentucky mines	$40.00
	Mexican. 70% F.o.b. border	$24.00-$24.50
	Acid Grade. 97% CaF_2, Bulk, F.o.b. Kentucky, Illinois, Colorado	$55.00
	Government buying F.o.b. producer's shipping point: 60% Illinois-Kentucky, $34.50 per ton, others $28.50; 70% Ill.-Ken. $38.50, others $32.50.	
PERLITE:	**Crude:** F.o.b. mine per short ton	$3.00 to $5.00
	Plaster grades. Crushed and sized. F.o.b. plants	$7.00 to $9.00
SULPHUR:	Long ton, F.o.b. Haskins Mound, Texas	$25.50
	Expert	$30.50

LONDON METAL AND MINERAL PRICES

		Per Long Ton	USA Equivalent	March 15, 1957 cents per pound
COPPER:	**Electrolytic spot**	£237	10s 0d	29.69¢
LEAD:	**Refined 99%**	£113	5s 0d	14.16¢
ZINC:	**Virgin, 98%**	£ 97	0s 0d	12.12¢
ALUMINUM:	**Ingot, 99.5%**	£197	0s 0d	24.625¢
ANTIMONY:	**Regulus, 99.6%**	£222	10s 0d	27.81¢
TIN:	**Standard, 99.75%**	£756	0s 0d	94.50¢
TUNGSTEN:	**Long ton unit**	1475		$20.58
		With Sterling pound at $2.80.		

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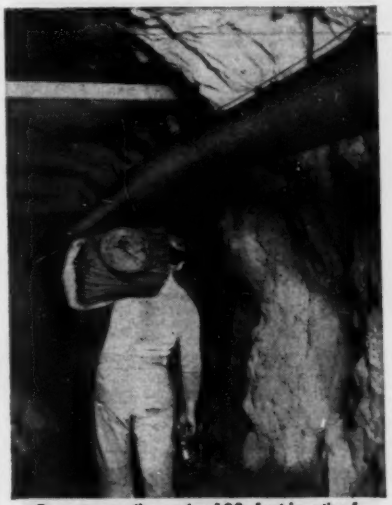

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1—161 CFM Chicago-Pneumatic PB-2
1—179 CFM Ingersoll-Rand NE-1
1—198 Sullivan WL-60
1—293 CFM Ingersoll-Rand Type 10
1—364 CFM Sullivan WG-9
1—445 CFM Worthington M-80
1—447 CFM Ingersoll-Rand Type 10
1—637 CFM Sullivan WJ3
1—698 CFM Union Low Pressure
1—800 CFM Ingersoll-Rand Type 10
3—105 CFM Ingersoll-Rand Portable Gas Engine Driven, Rubber Tire Mounted
1—105 CFM Schramm Portable, Gas Engine Driven, Rubber Tire Mounted
1—105 CFM Ingersoll-Rand, Portable, Gas Engine Driven
1—310 CFM Sullivan Portable, Gas Engine Driven

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1—4' x 4' Marcy Ball Mill
1—6' x 48" Hardinge Conical Ball Mill
1—8' x 22" Hardinge Conical Pebble Mill
1—5' x 8' Marcy Rod Mill

AIR TUGGERS
1—Ingersoll-Rand model D6U
5—Gardner-Denver model HK
1—Sullivan model L-111
2—Joy "Turbinair" model F-113
1—Ingersoll-Rand model HU
1—Gardner-Denver model HM

ELECTRIC SLUSHERS
1—5 HP Brownie tugger model HG
1—5 HP Sullivan tugger model DE
2—7½ HP Sullivan tuggers, model HE
5—5 HP Sullivan 2 drum model HDE
1—10 HP Sullivan 3 drum model HDE-10
1—15 HP Joy 2 drum model AF-212
2—20 HP Ingersoll-Rand 2 drum model 20NM
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1—20 cu. ft. rotary end dump, 18" ga.
3—21 cu. ft. rotary end dump, 18" ga.
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3—27 cu. ft. Koppel rocker dump cars, 24" ga.
6—54 cu. ft. Koppel rocker dump cars, 36" ga.
12—64 cu. ft. Truax rocker dump cars, 36" ga.

SCALES
1—2500# Fairbanks portable scale
1—3000# Fairbanks dial-type springless platform scale
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1—5 ton Howe "Weight-O-Graph" scale
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2—3" Wilfley Sand, overhead mount
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2—DFC muffle furnaces

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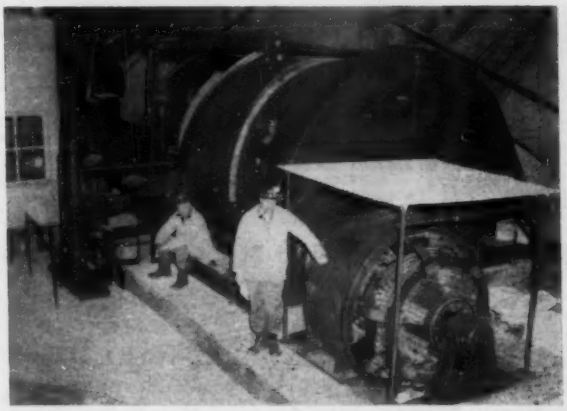

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1—100 HP Coeur d'Alene, 1 drum with motor and controls
1—150 HP Wellman-Seaver-Morgan 2 drum Mine Shaft Hoist, 8400 lbs @ 500 fpm, herringbone gears, post brakes, excellent unit.
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1—Mitchell Diamond Drill with air motor, EX rods.
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13—36 cu ft Rocker Dump, 24" ga EXCELLENT
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6—Atlas Copco Sinkers, ⅞ hex.
4—R-38 IR Stopehammers, ⅞ hex.

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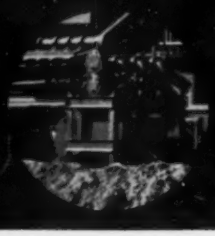

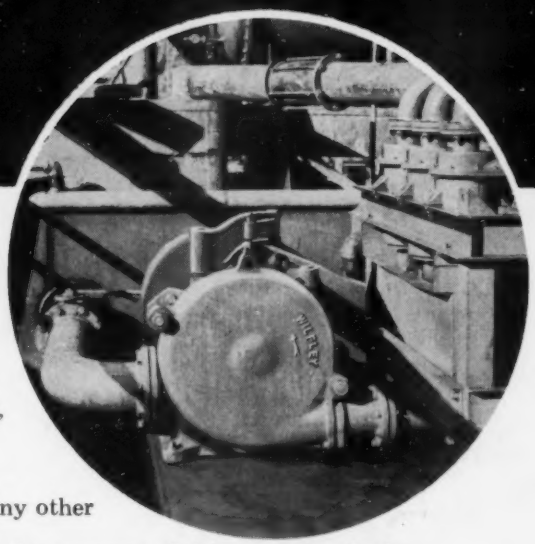

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